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ABSTRACT

Instructional materials on fuel and exhaust systems are provided for an auto mechanics course in the motor transportation technology program. Instructor's plans are provided for five units. Each unit consists of instructional and manipulative lessons. The format of an instructional lesson is as follows: the subject, aim, a listing of teaching aids and materials, a list of references, prerequisites, preparation of the learner through motivation, presentation of information (instructional topics/teaching points and student and teacher activities), application, verification and/or evaluation, summary, and suggested reading for students. Instructor's plans for manipulative lessons detail a task, its aim, tools and equipment, materials, teaching aids, references, prerequisites, checking standards, preparation of the learner through motivation, presentation of the skills (steps and key points), application, verification and/or evaluation, summary, and suggested readings for students. Information sheets, job sheets, and worksheets are also provided for each lesson. Topics covered in the lessons are gasoline (automotive fuel), carburetor air cleaners, crankcase ventilation, fuel tank, fuel pump, carburetor, heat riser, and exhaust system. (YLB)

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MOTOR TRANSPORTATION TECHNOLOGY

AUTOMECHANICS

BLOCK VII

A-VII

PRINTED 1978

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INFORMATION SHEET VII-A-1(IS)
ON
FUEL SYSTEM

SUBJECT: Gasoline

INTRODUCTORY INFORMATION:

Gasoline is a fuel used in internal combustion engines and is made up of the more volatile hydrocarbons found in crude oil. Hydrocarbon being a chemical compound of the two elements hydrogen and carbon. Gasolines differ in the number of hydrocarbons depending on the crude oil and the refining process.

Gasoline weighs out at approximately six pounds per gallon. One pound of quality fuel contains about 20,000 BTU. A gasoline with a higher heat content, upon being burned in a cylinder, will create more pressure. This results in more efficient engine performance and better gas mileage.

GENERAL INFORMATION:

Gasoline octane rating has kept pace with increased engine compression ratio. Octane ratings are from 55 for straight run gasoline to 104 for reformed gasoline with additives.

White gasoline has no tetraethyl lead added; therefore, it is a natural clear color. Dyes of various colors are added to gasoline to indicate that lead has been added.

Engine octane requirement varies in supposedly identical engines, but octane rating is predictable within limits, dependent upon such factors as: compression ratio, engine design, operation, spark timing and advance, intake manifold temperature, and carburetor fuel-air mixture.

With an engine that is properly tuned the most economical fuel to use is the lowest grade that will run without pre-ignition (pinging). Higher grade octane gasolines do not increase economy and efficiency in an engine unless the engine is specifically designed and tuned to utilize this higher grade fuel.

A good grade of fuel is a mixture of components with various boiling points, some of which evaporate easily at low temperature to facilitate an easy engine start when cold. As the engine begins to warm up to operating temperature other less volatile components begin to vaporize. Fuel containing a large number of highly volatile components will cause fuel pump vapor lock or percolation in the carburetor, thus octane rating of the fuel is lowered as these high octane components escape. Too many components of high boiling points prevent complete vaporization of fuel in the carburetor. This type fuel is wasted on starts and drains into the crankcase diluting the engine lubricant.

Most gasolines contain chemically unstable hydrocarbons. These chemically unstable hydrocarbons combine (polymerize) forming heavy, gummy hydrocarbons in the fuel system. These heavy, gummy hydrocarbons will cause carburetor jets to gum up and will cause valves to stick, as well as other parts when the gum is not removed. These gums are removed from an engine by various chemical means, either fed through the carburetor or added to the fuel. Better grade fuels have improved stability through chemical treatment, care in selection of crude oil for refining into fuel, and by gum - inhibiting additives.

It is wise to try and maintain, as nearly as possible, a full tank of gas at least over night. A fuel tank is vented in order to maintain atmospheric pressure for free fuel flow, thus air is present in the tank. Therefore, at night when the tank cools off moisture is condensed from the air. The water being heavier than the fuel will settle to the bottom of the tank. This water combines with the sulphur in the fuel creating caustic acids. This situation is aided through the use of filters and sediment bowls in fuel systems.

Fuel line freeze-up and carburetor icing are prevented by de-icer additives in fuel. These de-icer additives are either an anti-freeze or a surface - active agent. Surface - active agents coat ice particles and prevent them from sticking to metal surfaces.

Fuel line freeze-up is caused by too little service of fuel filters and sediment bowls. The water from the tank freezes in cold weather blocking the passage of fuel in the system.

Carburetor icing is the result of moisture condensing in the carburetor and being frozen. Gasoline vaporizing in the carburetor throat lowers the temperature by removing heat from the metal. Ice in the carburetor interferes with the flow of fuel and the movement of the throttle valve.

INSTRUCTOR'S LESSON PLAN VII-A-1(I)
INFORMATIONAL LESSON

SUBJECT:	GASOLINE (AUTOMOTIVE FUEL)
AIM:	THE STUDENT WILL BE ABLE TO DISCUSS THE FACTS AND CONDITIONS RELATIVE TO AUTOMOTIVE FUEL AND RELATE FUEL TROUBLES TO THE DIAGNOSIS OF FUEL SYSTEM PROBLEMS.
TEACHING AIDS:	CHALKBOARD AND STUDENT NOTEBOOK
MATERIALS:	GRAPHIC ILLUSTRATIONS OF GASOLINE HYDROCARBONS, TEACHER PREPARED
REFERENCES:	AUTOMOTIVE MECHANICS, PP. 165-170 AUTOMOTIVE ENCYCLOPEDIA, PP. 37, 209-211, 213-214
PREREQUISITE EXPERIENCE OF THE LEARNER:	TO HAVE SUCCESSFULLY COMPLETED PRIOR AUTOMOTIVE EXPERIENCES: EXHIBITING DEXTERITY, APTITUDE, AND MENTAL ABILITY, AS WELL AS PRACTICING SAFE WORK HABITS.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

THE MECHANIC WORKING IN, AROUND, AND WITH GASOLINE (AUTOMOTIVE FUEL) MUST ALWAYS BE ON THE ALERT AND PRACTICE SAFE WORKING HABITS. GASOLINE IS A VERY FINE SOLVENT, CLEANING AGENT, BUT IT IS NEVER TO BE USED AS SUCH. REMEMBER GASOLINE IS FLAMMABLE AND HIGHLY VOLATILE. GASOLINE IN THE GASEOUS STATE EXPLODES WITH CONSIDERABLE FORCE AND FUMES DO NOT MAKE GOOD BREATHING. IT IS DETRIMENTAL TO THE SKIN, CAUSING IT TO DRY AND CRACK. EVENTUALLY WITH EXPOSURE SORES WILL FORM.

AS GASOLINE IS BURNED IN AN AUTOMOTIVE ENGINE CO IS FORMED AND EXHAUSTED. CO, CARBON MONOXIDE, IS A DEADLY, COLORLESS, AND ODORLESS GAS. THEREFORE, AN ENGINE IS NOT TO BE RUN IN AN UNVENTED AREA. ALWAYS HAVE PLENTY OF VENTILATION OR AN EXHAUST SYSTEM FOR THE BUILDING WHEN ENGINES ARE BEING RUN.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
1. GASOLINE	1. DEFINITION - GASOLINE IS A HYDROCARBON FUEL BURNED IN AN INTERNAL COMBUSTION ENGINE 2. HYDROCARBON IS A CHEMICAL COMPOUND MADE UP OF HYDROGEN AND CARBON

PUT ON CHALKBOARD

```
H H H H H H H H
H-C-C-C-C-C-C-C-C-H
H H H H H H H H
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A. HEAVY HYDROCARBON
B. HIGH BOILING POINT

PUT ON CHALKBOARD

```
H H H H          H H H H
H-C C C C        C-C-C-C-H
H H H H          H H H H
```

a. LIGHT HYDROCARBON
b. HAS BEEN "CRACKED" BY REFINING
c. LOWER BOILING POINT
d. MORE VOLATILE

2. VOLATILITY

1. THE EASE OF VAPORIZATION
2. GASOLINE IS BLENDED WITH DIFFERENT HYDROCARBONS
   a. EASE OF STARTING
   b. GOOD ACCELERATION
   c. GOOD FUEL ECONOMY
   d. PREVENT VAPOR LOCKS

A. STARTING EASE

1. FOR STARTING COLD ENGINE
2. HIGHLY VOLATILE HYDROCARBON FOR RAPID VAPORIZATION
3. FUEL WITH TOO MANY LOW BOILING POINT HYDROCARBONS CAUSES
   a. FUEL PUMP VAPOR LOCK
   b. CARBURETOR PERCOLATION

B. VAPOR LOCK FREEDOM

1. HIGHLY VOLATILE HYDROCARBONS KEPT TO A MINIMUM IN FUEL MIXTURE
2. TO HELP MAINTAIN FREE FUEL FLOW

C. ENGINE WARM - UP

1. DIFFERENT HYDROCARBONS IN GRADUATED STEPS
2. AS ENGINE WARMS DIFFERENT HYDROCARBONS TAKE OVER AND BECOME VOLATILE
3. VOLATILITY OF HYDROCARBONS HIGH BUT LESS THAN THOSE FOR START

D. ACCELERATION

1. FOR SMOOTH ACCELERATION A PORTION OF THE FUEL MUST BE VOLATILE ENOUGH TO MIX PROPERLY WITH THE SUDDEN INCREASE IN AIR

2. TOO LITTLE FUEL MIXTURE IN AIR CAUSES VEHICLE TO STUTTER (HESITATE)
3. SHORTLY THEREAFTER THE MIXTURE BECOMES TOO RICH CAUSING ANOTHER STUTTER (HESITATION)

E. ECONOMY

1. HIGH HEAT CONTENT OF FUEL NEEDED
2. LOW VOLATILITY OF FUEL
3. LIMITED AMOUNT OF HIGH BOILING POINT HYDROCARBONS (LOW VOLATILITY)
4. LOW VOLATILITY INCREASES STARTING DIFICULTY
5. LOW VOLATILITY DOES NOT GIVE GOOD ACCELERATION
6. LOW VOLATILITY SLOWS DOWN THE SPEED OF WARM-UP
7. AFTER ENGINE WARM-UP HIGH BOILING POINT DOES GIVE BETTER FUEL MILEAGE

F. CRANKCASE DILUTION

1. LUBRICANT DILUTION CAUSED BY:
   a. RAW GAS ENTERING CYLINDER
   b. RUNS INTO PAN WITH OIL
2. RAW GAS WASHES CYLINDER WALLS CAUSING EXCESS WEAR
3. DILUTED OIL BECOMES LESS EFFICIENT CAUSING WEAR OF OTHER PARTS
4. FUEL MUST BE VOLATILE TO THE POINT WHERE VERY LITTLE OR EVEN NONE ENTERS THE CYLINDER IN A LIQUID STATE

3. ADDITIVES

1. OCTANE NUMBER RATING (VAPORIZING SUBSTANCES)
2. ANTIKNOCK COMPOUNDS (TETRAETHYL LEAD)
3. SCAVENGERS
   a. PREVENT LEAD DEPOSITS ON ENGINE PARTS
   b. ETHYLENE DIBROMIDE, ETHYLENE DICHLORIDE
   c. CAUSES LEAD COMPOUNDS TO VAPORIZE
4. OXIDATION INHIBITORS PREVENT GUM FORMATION OF FUEL IN STORAGE
5. METAL DEACTIVATORS PROTECT FUEL FROM HARMFUL EFFECTS OF METALS

5

a. PICKED UP IN REFINING
b. IN AUTOMOBILE FUEL SYSTEM

6. ANTIRUST AGENT PROTECTS VEHICLE FUEL SYSTEM
7. DE-ICERS
   a. PREVENT CARBURETOR JETS FROM GUMMING UP
   b. PREVENT CARBURETOR ICING
8. DETERGENTS
   a. PREVENT CARBURETOR JETS FROM GUMMING UP
   b. HELP PREVENT STICKING VALVES
   c. HELP PREVENT GUMMING OF OTHER PARTS
9. PHOSPHORUS COMPOUNDS
   a. PREVENT SPARK PLUG FOULING
   b. PREVENT SURFACE IGNITION
10. DYE TO IDENTIFY GASOLINE WITH ADDITIVES

ESSAY

1. DEFINE AUTOMOTIVE FUEL, GASOLINE.

ANSWER: GASOLINE IS NOT A SINGLE COMPOUND, IT IS A MIXTURE OF MANY COMPOUNDS KNOWN AS HYDROCARBONS.

2. WHAT IS A HYDROCARBON?

ANSWER: A HYDROCARBON IS A CHEMICAL COMPOUND MADE UP OF THE TWO ELEMENTS CARBON AND HYDROGEN.

3. EXPLAIN VOLATILITY.

ANSWER: VOLATILITY IS THE EASE WITH WHICH A LIQUID VAPORIZES.

4. WHAT IS THE MEANING OF THE TERM "VOLATILITY BLEND"?

ANSWER: A MIXTURE OF COMPONENTS WITH VARIOUS BOILING POINTS.

5. WHAT ARE THE CHARACTERISTICS OF THE HYDROCARBONS IN GASOLINE THAT GIVE GOOD FUEL MILEAGE?

ANSWER: 1. HIGH HEAT CONTENT
2. LOW VOLATILITY
3. HIGH BOILING POINT

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6. WHAT IS THE PURPOSE OF DYE IN GASOLINE?

ANSWER: DYE IDENTIFIES GASOLINE CONTAINING LEAD ADDITIVES.

7. WHAT TWO WAYS DO ANTI-ICERS ASSIST THE FUEL SYSTEM?

ANSWER: 1. THEY PREVENT FUEL LINE FREEZE UP.
2. THEY COAT ICE PARTICLES SO THAT THEY WILL NOT STICK TO METAL THEREBY PREVENT CARBURETOR ICING.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

1. A RUNNING ENGINE EXHAUSTS ____ GAS WHICH IS DEADLY TO HUMANS.	CO
2. HIGHLY VOLATILE GASOLINE CAN CAUSE ____ LOCK IN A FUEL SYSTEM.	VAPOR
3. GASOLINE IS DEFINED AS A ____ FUEL BURNED IN AN ENGINE.	HYDROCARBON
4. VOLATILITY IS THE EASE OF ____ OF A FUEL.	VAPORIZATION
5. GASOLINE WEIGHS APPROXIMATELY 6 POUNDS PER GALLON: THEREFORE; ONE POUND EQUALS 1/6 OF A GALLON OR ____ OUNCES.	21.33
6. CRANKCASE DILUTION IS CAUSED BY ____ POINT HYDROCARBONS ENTERING THE CYLINDER.	HIGH BOILING
7. GASOLINE SCAVENGING ADDITIVES CAUSE LEAD COMPOUNDS TO ____ AND BE EXHAUSTED OUT THE TAIL PIPE.	VAPORIZE
8. SPARK PLUG FOULING IS PREVENTED BY THE ____ COMPOUND ADDITIVES IN FUEL.	PHOSPHORUS

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. BE SURE TO EXERCISE SAFETY HABITS WHERE WORKING IN, AROUND, AND WITH GASOLINE.
   a. EXHAUST FUMES CONTAIN CO WHICH IS A DEADLY, COLORLESS, ODORLESS GAS.
   b. GASOLINE IS HIGHLY FLAMMABLE.
   c. GASOLINE DRIES THE SKIN, CAUSING IT TO CRACK AND CAUSE SORES.
   d. GASOLINE IS NOT TO BE USED AS A CLEANING AGENT.

e. GASOLINE HAS ONE PURPOSE AND THAT IS FUEL FOR AN ENGINE.

2. GASOLINE IS MADE UP OF HYDROCARBONS.

3. HYDROCARBONS ARE A COMBINATION OF HYDROGEN AND CARBON.

4. THROUGH THE REFINING PROCESS HYDROCARBONS CAN BE CRACKED, CAUSING THEM TO HAVE DIFFERENT VOLATILITY.

5. VOLATILITY IS THE ABILITY OF A FUEL TO VAPORIZE.

6. GASOLINES ARE BLENDS OF VARIOUS HYDROCARBONS IN ORDER TO:
   a. CAUSE AN ENGINE TO START EASY WHEN COLD.
   b. CAUSE AN ENGINE TO WARM UP PROPERLY.
   c. CAUSE AN ENGINE TO ACCELERATE PROPERLY.
   d. TO RUN ECONOMICALLY IN AN ENGINE.
   e. TO PREVENT VAPOR LOCK IN A FUEL SYSTEM.
   f. TO PREVENT CRANKCASE DILUTION.

7. ADDITIVES ARE PRESENT IN GASOLINE TO:
   a. ASSIST VAPORIZATION, OCTANE.
   b. PREVENT ENGINE KNOCKING, PRE-IGNITION.
   c. KEEP THE ENGINE AND PARTS CLEAN.
   d. PREVENT THE FORMATION OF SLUDGE AND SEDIMENTS.
   e. PROTECT FUEL FROM HARMFUL EFFECTS OF METAL.
   f. PREVENT RUST IN THE FUEL SYSTEM.
   g. PREVENT FUEL FREEZE UP AND ICING OF THE SYSTEM.
   h. DYES TO IDENTIFY TYPES OF FUELS.

SUGGESTED READING FOR THE STUDENT:

AUTOMOTIVE MECHANICS, CROUSE, PP. 132, 334-335
AUTOMECHANICS, GLENN PP. 161-162
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-30
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 241-292

THE NEXT LESSON IS: VII-A-2(I), "CARBURETOR AIR CLEANERS"

12

INSTRUCTOR'S PLAN VII-A-2(1)
INFORMATIONAL LESSON

SUBJECT: CARBURETOR AIR CLEANERS

AIM: THE STUDENT WILL BE ABLE TO COMPARE VARIOUS METHODS USED IN CLEANING AIR FOR INTERNAL COMBUSTION ENGINES.

TEACHING AIDS: TRANSPARENCIES: "GASOLINE ENGINES - DESCRIPTION, OPERATION, AND OVERHAUL", NO. 6003, FORD DIV., FORD MOTOR CO.
OIL BATH AND DRY TYPE AIR CLEANERS
CHALKBOARD

MATERIALS: CHALK

REFERENCES: AUTOMOTIVE MECHANICS, CROUSE, PP. 132, 334-335
AUTOMECHANICS, GLENN, 161-162
AUTO SERVICE AND REPAIR, STOCKEL, 20-30
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, 241-242

PREREQUISITE EXPERIENCE OF THE LEARNER: THE STUDENT SHOULD HAVE READ THE REFERENCES FOR THIS LESSON.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

AN AUTOMOBILE ENGINE USES A GREAT DEAL OF AIR IN NORMAL OPERATION. IT MAY CONSUME AS MUCH AS A HUNDRED CUBIC FEET OF AIR FOR EVERY MILE THE CAR IS DRIVEN. CONSIDERING HOW MUCH THAT WOULD BE IN A THOUSAND MILES, AND THE AMOUNT OF DUST AND FLOATING PARTICLES IT MIGHT CONTAIN, WE CAN UNDERSTAND THE NEED FOR CLEANING THE AIR BEFORE IT ENTERS THE ENGINE. HOW THIS IS DONE IS THE SUBJECT OF TODAY'S LESSON.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PURPOSE OF AIR CLEANER	1. PRIMARY FUNCTION IS REMOVAL OF DUST AND GRIT FROM AIR 2. MUFFLES NOISE OF AIR RUSHING INTO CARBURETOR AIR HORN 3. ARRESTS FLAME WHEN ENGINE BACKFIRES THROUGH CARBURETOR

B. TYPES

1. OIL SATURATED IS OLDER TYPE CLEANER
   a. AIR GOES THROUGH FINE MESH SCREEN
   b. SCREEN SATURATED WITH ENGINE OIL
   c. DUST STICKS TO OILY SCREEN
   d. NOT VERY EFFICIENT IN OPERATION
      (1) MAY BECOME CLOGGED WITH DUST
      (2) RESTRICTED AIR FLOW AFFECTS AIR-FUEL RATIO
      (3) CAN RESULT IN POOR ENGINE PERFORMANCE
      (4) ALLOWS SMALLER DUST PARTICLES THROUGH
   e. REQUIRES FREQUENT SERVICE
      (1) SCREEN WASHED IN SOLVENT
      (2) DIPPED IN ENGINE OIL
      (3) SERVICE RECOMMENDED EVERY 1,000 MILES OR SOONER
2. OIL BATH TYPE IS MORE EFFICIENT
   a. AIR FORCED TO REVERSE DIRECTION OVER OIL POOL
   b. MOST DUST PARTICLES FALL INTO OIL
   c. AIR THEN PASSES THROUGH OIL SATURATED SCREEN
   d. SILENCER REDUCES AIR NOISE
   e. SERVICE RECOMMENDED EVERY 5,000 MILES
      (1) SCREEN CLEANED AND CONDITIONED AS IN OIL SATURATED TYPE
      (2) OIL BATH PART EMPTIED AND SCRAPED
      (3) FILLED WITH 40 WEIGHT ENGINE OIL
3. PAPER ELEMENT TYPES ARE VERY EFFICIENT
   a. FILTER IS COMPOSED OF SPECIAL PAPER
   b. ACCORDIAN-LIKE FOLDS ALLOW MORE SURFACE AREA FOR AIR PAS-

SAGE
c. PLASTIC RINGS SEAL TOP AND BOTTOM
d. FILTER REMOVED FROM HOUSING AND CLEANED BY:
(1) TAPPING AGAINST HARD SURFACE
(2) BLOWING FROM INSIDE RING WITH AIR HOSE

NOTE: NEVER PLACE IN CLEANING SOLUTION

4. DUAL STAGE CLEANER FOR HEAVY DUTY USE
a. HAS OIL SATURATED PAPER INNER FILTER THAT IS REPLACEABLE
b. GLYCOL SATURATED OUTER FILTER COMPOSED OF POLYURETHANE FOAM
c. OUTER ELEMENT SERVICED EVERY 12,000 MILES
(1) WASHED IN CLEANING SOLVENT
(2) SATURATED WITH 30 WEIGHT OIL

CAUTION: POLYURETHANE TEARS EASILY. NEVER WRING OR SHAKE IT TO REMOVE EXCESS OIL

C. CLEANERS ON EMISSION CONTROLLED ENGINES
1. SOME AIR CLEANERS USED IN EMISSION CONTROL
2. HOSE CONNECTS AIR CLEANER WITH CRANKCASE BREATHER CAP
3. AIR TRAVELS THROUGH CLEANER INTO CRANKCASE
4. SERVICE OF AIR CLEANER INCLUDES HOSE OR TUBING AND FITTING INSPECTION
5. THIS IS CALLED "CLOSED" CRANKCASE

D. CONSTRUCTION
1. AIR CLEANERS ARE VARIABLE IN DESIGN
2. FILTERS USUALLY ENCLOSED IN HOUSING
3. REMOVABLE COVER ALLOWS ACCESS TO FILTER

4. HOUSING MAY BOLT TO SUPPORT BRACE
5. RING CLAMP ATTACHES HOUSING TO CARBURETOR

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

SHOW STUDENTS CARBURETOR AIR CLEANERS. DISASSEMBLE AND SHOW HOW FILTERS ARE CONSTRUCTED. DRAW DIAGRAM SHOWING AIR FLOW THROUGH HOUSING AND FILTER ON CHALKBOARD. SHOW TRANSPARENCIES AND DISCUSS.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

QUESTIONS: SIMPLE RECALL

1. WHY DOES AN ENGINE NEED AN AIR CLEANER?

   AN AUTOMOBILE USES ABOUT A HUNDRED CUBIC FEET OF AIR PER MILE, AND THE AIR HAS DUST AND GRIT IN IT. THESE ABRASIVES CAN CAUSE RAPID ENGINE WEAR IF THEY GET INTO THE CYLINDERS.

2. WHAT ARE THE FUNCTIONS OF AN AIR CLEANER?

   THE PRIMARY FUNCTION IS REMOVAL OF DUST AND GRIT FROM AIR GOING INTO THE ENGINE, BUT IT ALSO ACTS AS A MUFFLER AND FLAME ARRESTER.

3. DESCRIBE THE OLDER TYPE AIR CLEANER FOUND ON EARLY AUTOMOBILES.

   THE CLEANER HAD AN OIL SATURATED WIRE MESH SCREEN TO TRAP DUST PARTICLES. IT WAS ONLY FAIRLY EFFICIENT AND REQUIRED FREQUENT SERVICE.

4. WHY DID THE OIL BATH CLEANER REPLACE THE OLDER TYPE?

   IT DID A MUCH BETTER JOB OF CLEANING THE AIR AND REQUIRED LESS FREQUENT SERVICE.

5. WHAT ARE SOME ADVANTAGES OF A DRY PAPER FILTER?

   THEY ARE MUCH MORE EFFICIENT THAN THE OIL TYPE AND ARE EASILY CLEANED FOR REUSE.

6. DESCRIBE A DUAL STAGE OR HEAVY DUTY AIR CLEANER.

   THIS CLEANER HAS AN OIL SATURATED PAPER INNER FILTER AND A

GLYCOL SATURATED FOAM OUTER FILTER.

7. HOW IS A POLYURETHANE FILTER SERVICED?

   IT IS REMOVED, WASHED IN SOLVENT, SATURATED WITH 30 WEIGHT OIL, AND RETURNED TO THE HOUSING.

8. EXPLAIN HOW AIR CLEANERS ARE USED IN EMISSION CONTROL.

   AIR GOING INTO THE CRANKCASE IS BROUGHT IN FROM THE AIR CLEANER THROUGH A HOSE.

9. WHAT ARE THE TWO MAIN COMPONENTS OF MOST AIR CLEANERS?

   MOST HAVE A FILTER ENCLOSED IN A HOUSING.

10. HOW ARE AIR CLEANERS SUPPORTED?

    THEY ATTACH TO THE CARBURETOR WITH A RING CLAMP AND MAY ALSO BOLT TO A BRACE SUPPORT.

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

DUE TO THE VOLUME OF AIR USED BY AN ENGINE AND THE FOREIGN PARTICLES IT CONTAINS, AIR CLEANERS ARE NECESSARY FOR EFFICIENT, LONG LASTING OPERATION.

SEVERAL TYPES OF AIR CLEANERS HAVE BEEN USED, BUT BECAUSE THEY WERE INEFFICIENT OR REQUIRED SERVICE TOO FREQUENTLY, MOST HAVE GIVEN WAY TO EITHER DRY FILTERS OR DUAL STAGE CLEANERS.

AIR CLEANERS ARE USED IN EMISSION CONTROL BY CONNECTING THEM WITH THE CRANKCASE BREATHER CAP. THIS DIRECTS AIR THROUGH THE FILTER BEFORE IT ENTERS THE CRANKCASE.

SUGGESTED READING FOR THE STUDENT:

AUTOMECHANICS, GLENN, PP. 88-90

THE NEXT LESSON IS: VII-A-3(I), "CRANKCASE VENTILATION"

INSTRUCTOR'S PLAN VII-A-3(I)
INFORMATIONAL LESSON

SUBJECT: CRANKCASE VENTILATION

AIM: THE STUDENT WILL BE ABLE TO COMPARE CRANKCASE VENTILATION SYSTEMS AND DEFINE THEIR PURPOSE AND FUNCTION.

TEACHING AIDS: TRANSPARENCIES: "GASOLINE ENGINES - DESCRIPTION, OPERATION, AND OVERHAUL", NO. 6003, FORD DIV., FORD MOTOR CO.
PVC

MATERIALS: CHALK

REFERENCES: AUTOMOTIVE MECHANICS, CROUSE, PP. 171-172, 328
AUTOMECHANICS, GLENN, P. 88-90
AUTO SERVICE AND REPAIR, STOCKEL, CH. 17
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, P. 100

PREREQUISITE EXPERIENCE OF THE LEARNER: THE STUDENT SHOULD HAVE READ THE REFERENCES FOR THIS LESSON.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

FOR EVERY GALLON OF GASOLINE BURNED IN AN ENGINE, ABOUT A GALLON OF WATER IS FORMED BY THE COMBUSTION PROCESS. MOST OF IT GOES OUT THE EXHAUST, BUT SOME WATER VAPORS GET PAST THE PISTON RINGS AND DOWN INTO THE CRANKCASE. MIX THIS WATER VAPOR WITH OIL AND THE GASOLINE WHICH GETS BY THE RINGS THE SAME WAY, AND THE ENGINE NO LONGER HAS A GOOD LUBRICANT BUT A THICK, GUMMY SLUDGE WHICH GREATLY DECREASES ENGINE PERFORMANCE. THE METHOD USED TO AVOID THIS IS OUR TOPIC TODAY.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENT TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PURPOSE OF VENTILATION	1. WATER IS FORMED IN THE COMBUSTION PROCESS
	a. BLOW-BY CARRIES WATER VAPOR PAST PISTON
	b. MIXES WITH OIL TO FORM SLUDGE

2. COMBUSTION OF GASOLINE IS NEVER COMPLETE
   a. CHOKING TO START COLD ENGINE LEAVES RAW GASOLINE
   b. GASOLINE ENTERS THE CRANKCASE AND THINS THE OIL
3. BEST SLUDGE PREVENTION IS REMOVAL OF WATER AND GASOLINE BEFORE REACTION TAKES PLACE
   a. THIS IS PRIMARY FUNCTION OF VENTILATION SYSTEM
   b. LONG DISTANCE DRIVING BEATS CRANKCASE OIL
   c. WATER AND GASOLINE ARE BOILED OUT
   d. VENTILATION OF CRANKCASE CARRIES VAPORS AWAY

B. TYPES OF SYSTEMS

1. OPEN SYSTEM
   1. VENT TUBE SYSTEM ON OLDER ENGINES
      a. ROAD-DRAFT SYSTEM OF VENTILATION
      b. OPENING AT FRONT OF CRANKCASE ALLOWED AIR IN
      c. TUBE IN BACK LET AIR OUT
         (1) OPENING AT END SET AT ANGLE
         (2) PASSING AIR CREATED VACUUM
   2. SYSTEM EFFICIENT ONLY AT HIGH SPEED
      a. NO VACUUM CREATED AT LOW SPEED
      b. RELEASED VAPORS INTO ATMOSPHERE

2. CLOSED SYSTEM
   1. SYSTEM ON MOST MODELS SINCE 1964
      a. INTAKE MANIFOLD SUCKS IN VAPORS ON SOME MODELS
      b. VACUUM CREATED BY AIR IN CARBURETOR DOES SAME ON OTHERS
      c. VACUUM ACTUATES A CONTROL VALVE
         (1) CALLED A POSITIVE CONTROL VALVE OR PCV

(2) VACUUM DROP OPENS VALVE
(3) ALLOWS CIRCULATION OF AIR THROUGH CRANKCASE

2. A POSITIVE TYPE VENTILATOR
3. SINCE 1968 HAS BEEN REQUIRED BY LAW

C. CRANKCASE EMISSION CONTROL

1. HOSE CONNECTS AIR BREATHER WITH OIL FILLER CAP
2. FILTERED AIR AND GASOLINE FUMES DRAWN INTO OIL PASSAGES OF ENGINE
3. CIRCULATES THROUGH ENGINE PICKING UP VAPORS
4. EXITS THROUGH HOSE CONNECTED TO VALVE COVER
5. PCV LOCATED IN HOSE ADJUSTS AIR FLOW
6. HOSE IS CONNECTED TO INTAKE MANIFOLD
7. VAPORS AND FUMES ARE BURNED IN CYLINDERS
8. EMISSION OF POLLUTANTS FROM BOTH CARBURETOR AND CRANKCASE CONTROLLED IN THIS WAY

D. PCV OPERATION

1. IDLE SPEED CREATES HIGH VACUUM IN INTAKE MANIFOLD
2. HIGH VACUUM CLOSES PCV VALVE REDUCING AIR FLOW
3. REDUCTION OF AIR GIVES BETTER AIR-FUEL RATIO FOR IDLE SPEED

E. SERVICE CONSIDERATIONS

1. VENTILATION SYSTEM PARTS NEED FREQUENT CLEANING
2. VALVE MAY BECOME CLOGGED WITH CARBON
   a. CAUSES PRESSURE IN CRANKCASE
   b. FORCES OIL OUT MAIN BEARINGS
3. VALVE MAY NOT SEAT OR CLOSE CAUSING POOR IDLE
4. CLEANING OR REPLACEMENT OF OIL FILLER CAP NECESSARY ON SOME OLDER MODELS

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK QUESTIONS TO STIMULATE CLASS DISCUSSION AND CHECK COMPREHENSION OF MATERIALS PRESENTED.

EXAMPLE: WHAT IS THE BEST WAY TO PREVENT SLUDGE FROM FORMING IN AN ENGINE CRANKCASE?

ANSWER: BY REMOVING THE AGENTS THAT REACT WITH OIL TO FORM SLUDGE, THE PROBLEM IS SOLVED BEFORE IT BEGINS. RUNNING AN ENGINE LONG ENOUGH TO HEAT THE OIL ABOVE THE BOILING POINTS OF WATER AND GASOLINE CAUSES THEM TO VAPORIZE. THE VAPOR IS THEN CARRIED OFF BY CIRCULATING AIR.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

TRUE - FALSE TEST

1.	A PINT OF WATER IS FORMED FOR EVERY GALLON OF GASOLINE THAT IS USED IN AN ENGINE.	F
2.	"BLOW-BY" REFERS TO WATER BEING CARRIED PAST THE PISTON.	T
3.	OVER-CHOKING A COLD ENGINE CAN THIN THE OIL IN THE CRANKCASE.	T
4.	RUNNING AN ENGINE FOR ONLY SHORT PERIODS CAN DECREASE ITS LUBRICATING EFFICIENCY.	T
5.	THE PRIMARY FUNCTION OF AN ENGINE VENTILATION SYSTEM IS TO REMOVE DUST AND GRIT FROM THE OIL.	F
6.	"ROAD-DRAFT" AND "VENT TUBE" WERE NAMES FOR THE SAME TYPE VENTILATION SYSTEM.	T
7.	ALL AMERICAN MADE CARS NOW HAVE CLOSED VENTILATION SYSTEMS.	F
8.	THE PCV IS OPERATED BY VACUUM.	T
9.	LOCATION OF THE PCV IS BETWEEN AIR BREATHER AND VENTILATION INLET.	F
10.	ENGINE EFFICIENCY MAY BE DIRECTLY RELATED TO THE CONDITION OF ITS VENTILATION SYSTEM.	T

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

WATER IS A NATURAL PRODUCT FORMED IN THE COMBUSTION PROCESS. SOME OF IT, ALONG WITH UNBURNED GASOLINE, GETS PAST THE PISTON RINGS DOWN INTO THE CRANKCASE. IF ALLOWED TO REMAIN THERE, THEY DILUTE THE OIL AND FORM A SLUDGE WHICH REDUCES ENGINE EFFICIENCY.

DURING LONG DRIVES ENGINE OIL IS HEATED ABOVE THE BOILING POINTS OF BOTH GASOLINE AND WATER. THEY ARE VAPORIZED AND REMOVED BY THE VENTILATION SYSTEM.

BEFORE AIR POLLUTION BECAME SUCH A PROBLEM IN LARGER CITIES, ENGINES WERE BUILT WITH A VENT-TUBE VENTILATION SYSTEM WHICH OPERATED ON A ROAD DRAFT PRINCIPLE. IT WAS, HOWEVER, INEFFICIENT AT LOW SPEEDS AND CONTRIBUTED TO AIR POLLUTION BY VENTING THE VAPORS INTO THE ATMOSPHERE.

AT PRESENT, LAW REQUIRES THAT ENGINES BEING MANUFACTURED HAVE CLOSED VENTILATION SYSTEMS THAT CONTROL BOTH CARBURETOR AND CRANKCASE EMISSIONS BY BURNING THEM IN THE CYLINDERS.

SUGGESTED READING FOR THE STUDENT:

AUTOMOTIVE MECHANICS, CROUSE, CH. 6

THE NEXT LESSON IS: VII-B-1(I), "FUEL TANK"

INSTRUCTOR'S PLAN VII-A-1(S)
MANIPULATIVE LESSON

TASK: SERVICE CARBURETOR AIR CLEANER

AIM:
1. STUDENT WILL BE ABLE TO DIAGNOSE AIR CLEANER PROBLEMS
2. STUDENT WILL BE ABLE TO REPAIR OR SERVICE ALL AIR CLEANERS

TOOLS AND EQUIPMENT: BASIC HAND TOOLS AND PARTS WASHER

MATERIALS: CLEAN RAGS

TEACHING AIDS: MANUFACTURER'S SPECIFICATIONS

REFERENCES: AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 253
AUTO SERVICE AND REPAIR, STOCKEL, 20-30 TO 20-33

PREREQUISITE EXPERIENCE OF THE LEARNER: MUST HAVE SUCCESSFULLY PASSED TEST ON: VII-A-1(I) "CARBURETOR AIR CLEANERS"

CHECKING STANDARDS:
1. SELECT THE PROPER TOOLS AND EQUIPMENT
2. MAINTAIN CRAFTSMANLIKE WORK
3. APPRECIATION FOR TOOLS, EQUIPMENT, AND AUTOMOBILE
4. FOLLOW STANDARD PROCEDURE AS SET FORTH BY THE INSTRUCTOR

I. PREPARATION (OF THE LEARNER - MOTIVATION)

1. WHY DOES AN ENGINE REQUIRE AN AIR CLEANER?
   a. PRIMARY FUNCTION IS REMOVAL OF DUST AND GRIT FROM AIR
   b. MUFFLE NOISE OR AIR RUSHING INTO CARBURETOR AIR HORN
   c. ARREST FLAME WHEN ENGINE BACKFIRES THROUGH CARBURETOR
2. HOW IS AIR CLEANED?
   a. OIL SATURATION IS THE OLDER TYPE OF CLEANER
   b. OIL BATH TYPE IS MORE EFFICIENT THAN OIL SATURATION
   c. PAPER TYPE IS THE MOST EFFICIENT

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. DEMONSTRATE	1. STEP BY STEP 2. EMPHASIZE KEY POINTS 3. QUESTION STUDENTS AS DEMONSTRA-

	TION PROGRESSES 4. EMPHASIZE SAFETY AND CAUTIONS 5. STRESS CRAFTSMANSHIP
2. REMOVE AIR CLEANER FROM VEHICLE	1. REMOVE WING NUT ATTACHING AIR CLEANER BODY TO CARBURETOR 2. DISCONNECT CRANKCASE VENTILATION HOSE AT AIR CLEANER BODY 3. DISCONNECT VACUUM HOSE FOR AIR CLEANER VALVE 4. REMOVE AIR CLEANER AS AN ASSEMBLY CAUTION: TO PREVENT DIRT FROM ENTERING CARBURETOR, ALWAYS REMOVE AIR CLEANER BODY FROM CARBURETOR BEFORE REMOVING AIR CLEANER ELEMENT
3. REPLACE AIR CLEANER ASSEMBLY	1. WASH AIR CLEANER BODY AND COVER IN CLEANING SOLVENT CAUTION: NEVER WASH PAPER FILTER ELEMENT WITH ANYTHING 2. INSPECT FILTER ELEMENT AND REPLACE IF NEEDED 3. INSPECT VENTILATION FILTER AND REPLACE IF NEEDED 4. INSPECT CARBURETOR THROAT GASKET AND REPLACE IF NEEDED 5. PLACE AIR CLEANER BODY ON CARBURETOR NOTE: MAKE SURE AIR INTAKE DUCT AND HOT AIR INTAKE TUBE ARE PROPERLY ALIGNED 6. PLACE AIR FILTER ELEMENT IN AIR CLEANER BODY NOTE: BE SURE TOP SIDE OF ELEMENT IS UP, COVER SIDE AND ELEMENT IS PROPERLY SEATED 7. PUSH VACUUM HOSE FOR AIR CLEANER VALVE AND CRANKCASE VENTILATING HOSE BACK ON RESPECTIVE FITTINGS 8. SECURE WING NUT ON COVER BOLT A TURN TO RIGHT (CLOCKWISE). TIGHTEN TO SPECIFICATIONS
4. MAKE VEHICLE READY	1. CONNECT BATTERY 2. REMOVE ALL TOOLS FROM VEHICLE

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	3. MOVE VEHICLE TO PARKING AREA
5. CLEAN WORK STATION	1. CLEAN TOOLS AND RETURN TO STORAGE AREA
	2. SWEEP WORK STATION
	3. PICK UP AND PLACE RESIDUE IN TRASH
	4. RETURN CLEANING EQUIPMENT TO STORAGE

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. STUDENT TO REPEAT ORALLY STEPS OF THE TASK.
2. CHECK STUDENTS FOR COMPREHENSION OF KEY POINTS.
3. CHECK STUDENTS FOR POINTS OF SAFETY.
4. STUDENTS TO PRACTICE ON TASK. USE JOB SHEET VII-A-1(J)

IV. VERIFICATION AND/OR EVALUATION (CHECK OF STUDENTS' ABILITY)

1. PUT STUDENTS ON THEIR OWN TO PERFORM TASKS.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. REPEAT EACH STEP FROM STAGE II AND EMPHASIZE PERTINENT POINTS.
2. REEMPHASIZE NEED FOR SAFETY.
3. STRESS POINTS CONCERNING CARE OF THE CUSTOMER'S PROPERTY.
4. EMPHASIZE CLEANLINESS WITH WORK.
5. REEMPHASIZE HIGHLIGHTS OF KEY POINTS.

SUGGESTED READING FOR STUDENTS:

AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 253
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-30 TO 20-33

THE NEXT LESSON IS: VII-B-1(S), "SERVICE FUEL TANK FOR 1975 FORD AND MERCURY"

JOB SHEET
IN
FUEL SYSTEM

VII-A-1 (J)

JOB:	SERVICE CARBURETOR AIR CLEANER	
MATERIALS:	CLEAN RAGS	
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS AND 2 FENDER COVERS	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THE JOB THE STUDENT SHOULD REVIEW: AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 253 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-30 TO 20-33	
PROCEDURE AND/OR TASKS:	VII-A-1(TS)	PREPARE VEHICLE
	VII-A-1a(TS)	REMOVE AIR CLEANER FROM VEHICLE
	VII-A-1b(TS)	REPLACE AIR CLEANER ASSEMBLY
	VII-A-1c(TS)	MAKE VEHICLE READY
	VII-A-1d(TS)	CLEAN WORK AREA
CHECKING STANDARDS	1. OBSERVATION OF PROTECTING PAINT ON VEHICLE 2. OBSERVATION OF SAFETY STANDARDS 3. USE OF TOOLS 4. TAKE MENTAL NOTES OF ALL NEW TASKS AT HAND	

TASK SHEET VII-A-1(TS)

TASK: PREPARE VEHICLE

JOB: SERVICE CARBURETOR AIR CLEANER

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BATTERY PLIERS AND SAFETY GOGGLES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. START ENGINE 2. DRIVE VEHICLE INTO WORK AREA 3. ALIGN VEHICLE IN WORK AREA a. USE ASSISTANT b. HAVE ASSISTANT STAND CLEAR OF VEHICLE 4. PUT VEHICLE IN NEUTRAL 5. SET FOOT OR HAND BRAKE
2. PERFORM VEHICLE SAFETY	1. CAUTION: DISCONNECT NEGATIVE BATTERY CABLE 2. REMOVE POSITIVE CABLE NOTE: USE BATTERY PLIERS OR PULLER IF NECESSARY

TASK: REMOVE AIR CLEANER FROM VEHICLE

JOB: SERVICE CARBURETOR AIR CLEANER

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEAN RAGS, FENDER COVERS, DROP LIGHT, AND SMALL ADJUSTABLE WRENCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE ATTACHING WING NUT	1. TURN NUT TO LEFT (COUNTERCLOCKWISE) 2. PLACE NUT IN CONTAINER
2. DISCONNECT CRANKCASE VENTILATION HOSE	1. PULL AND TWIST HOSE, BY HAND, TO RELEASE FROM FITTING 2. COVER OPENING WHERE HOSE WAS CONNECTED
3. DISCONNECT VACUUM HOSE FROM CARBURETOR	1. PULL AND TWIST HOSE, BY HAND, TO RELEASE FROM FITTING 2. COVER OPENING WHERE HOSE WAS CONNECTED WITH SHOP TOWEL
4. DISCONNECT AIR CLEANER FROM CARBURETOR	1. LIFT AIR CLEANER ASSEMBLY FROM CARBURETOR CAUTION: TO PREVENT DIRT FROM ENTERING CARBURETOR, ALWAY REMOVE AIR CLEANER AS AN ASSEMBLY 2. PLACE ASSEMBLY ON WORK BENCH

TASK: REPLACE AIR CLEANER ASSEMBLY

JOB: SERVICE CARBURETOR AIR CLEANER

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEANING SOLVENT IN WASH PAN, CLEAN RAGS, SAFETY GOGGLES, PARTS WASHING BRUSH, AND SMALL ADJUSTABLE WRENCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. WASH PARTS	1. WASH AIR CLEANER BODY AND COVER WITH CLEANING SOLVENT NOTE: NEVER WASH PAPER FILTER ELEMENT WITH ANYTHING 2. WIPE BODY AND COVER DRY WITH CLEAN RAG
2. INSPECT PARTS	1. VISUALLY INSPECT FILTER ELEMENT NOTE: REPLACE IF NEEDED 2. VISUALLY INSPECT VENTILATION FILTER NOTE: REPLACE IF NEEDED 3. VISUALLY INSPECT CARBURETOR THROAT GASKET NOTE: REPLACE IF NEEDED
3. INSTALL AIR CLEANER ASSEMBLY	1. POSITION AIR CLEANER BODY ON CARBURETOR NOTE: MAKE SURE AIR INTAKE DUCT AND HOT AIR INTAKE TUBE ARE PROPERLY ALIGNED 2. PLACE AIR FILTER ELEMENT IN AIR CLEANER BODY NOTE: MAKE SURE TOP SIDE OF FILTER ELEMENT IS UP AND ELEMENT IS PROPERLY SEATED 3. PUSH VACUUM HOSE FOR AIR CLEANER VALVE AND VENTILATION HOSE BACK ONTO THEIR RESPECTIVE FITTINGS 4. PLACE COVER ON AIR CLEANER BODY 5. SECURE WING NUT ON COVER BOLT a. TURN NUT TO RIGHT (CLOCKWISE) b. TIGHTEN TO SPECIFICATIONS

TASK: MAKE VEHICLE READY

JOB: SERVICE CARBURETOR AIR CLEANER

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BATTERY PLIERS OR BATTERY CLAMP PULLER AND CLEAN WIPING RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CONNECT BATTERY	1. CONNECT POSITIVE CABLE NOTE: INSPECT POST AND CLAMP. CLEAN IF NECESSARY 2. TIGHTEN CLAMP FIRMLY 3. CONNECT NEGATIVE CABLE NOTE: INSPECT POST AND CLAMP. CLEAN IF NECESSARY 4. TIGHTEN CLAMP FIRMLY
2. REMOVE TOOLS	1. REMOVE COVERS FROM FENDERS 2. FOLD COVERS FOR STORING 3. RETURN COVERS TO STORAGE AREA 4. INSPECT CAR FOR TOOLS
3. RETURN VEHICLE TO PARKING AREA	1. WIPE FENDERS OF ANY GREASE OR DIRT CAUSED BY WORK PERFORMED 2. START ENGINE 3. REMOVE FROM WORK AREA CAUTION: USE AN ASSISTANT WHEN BACKING UP FOR SAFETY PURPOSES 4. RETURN TO PARKING AREA 5. RETURN CAR KEYS TO INSTRUCTOR

TASK: CLEAN WORK AREA

JOB: SERVICE CARBURETOR AIR CLEANER

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEAN RAGS, FLOOR BROOM, AND DUST PAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SECURE TOOLS	1. PICK UP ALL TOOLS USED 2. WIPE TOOLS CLEAN 3. RETURN TO TOOL STORAGE
2. SECURE WORK AREA	1. PLACE ALL TRASH IN DISPOSAL CANS 2. SWEEP WORK AREA CLEAN 3. PICK UP DIRT AND RESIDUE IN DUST PAN 4. PLACE DIRT AND RESIDUE IN DISPOSAL CANS 5. RETURN BROOM AND DUST PAN TO STORAGE AREA

INSTRUCTOR'S PLAN VII-B-1(I)
INFORMATIONAL LESSON

SUBJECT:	FUEL TANK
AIM:	THE STUDENT WILL BE ABLE TO DESCRIBE FUEL TANK COMPONENTS AND THEIR FUNCTION.
TEACHING AIDS:	TRANSPARENCIES I. ED. II 7T, FIGS. 556-559 VARIOUS TYPES FUEL FILTERS CHALK BOARD
MATERIALS:	CHALK
REFERENCES:	AUTOMOTIVE MECHANICS, CROUSE, CHS. 9 AND 20 AUTOMECHANICS, GLENN, CH. 6 AUTO SERVICE AND REPAIR, STOCKEL, CH. 20 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 255-270
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE STUDENT SHOULD HAVE READ THE REFERENCES FOR THIS LESSON.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

WE HAVE COME A LONG WAY FROM THE TIME WHEN A CAR ENGINE WAS GRAVITY FED FROM THE FUEL TANK MOUNTED HIGHER THAN ITSELF. FUEL SYSTEMS ON MODERN VEHICLES INCLUDE THE CARBURETOR, FUEL PUMP, CONNECTING HOSES AND TUBING, AND THE FUEL TANK WITH ITS FILTERS AND GAUGES. TODAY WE WILL LEARN ABOUT THE COMPONENTS THAT MAKE UP THE FUEL RESERVOIR MORE COMMONLY KNOWN AS A "GAS TANK."

II. PRESENTATION (OF THE INFORMATION

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. TYPES OF FUEL TANKS	1. CONSTRUCTED OF HIGH GRADE SHEET STEEL 2. METAL THICKNESS DEPENDS ON: a. VOLUME CONTAINED - LARGER TANKS REQUIRE MORE STRENGTH TO SUSTAIN EXTRA WEIGHT b. TYPE FUEL - BUTANE AND PROPANE PRODUCE MUCH PRESSURE AND NEED VERY STRONG TANKS 3. VOLUME USUALLY RELATES TO SIZE OF VEHICLE

4. SOME TANKS HAVE FUEL PUMP INSIDE

B. LOCATION AND SUPPORTS

1. TANK USUALLY LOCATED IN REAR OF VEHICLE
2. SPACE PROVIDED IN CAR FRAME
3. FRAME PROTECTS FUEL TANK IN COLLISIONS
4. STEEL STRAPS SUPPORT TANK
   a. FIT IN GROOVES OF TANK
   b. BOLT AND NUT END PROVIDE FOR REMOVAL
5. INSULATION BETWEEN TANK AND BODY ADDS PROTECTION AND REDUCES NOISE
6. INTERNAL BAFFLES INHIBIT MOVEMENT OF FUEL

SHOW: TRANSPARENCIES FIGS. 556-559

C. VENTILATION SYSTEMS

1. OLDER DESIGNS VENTED TO ATMOSPHERE
2. WAS CONTRIBUTING FACTOR TO SMOG FORMATION
3. SINCE 1970 CARS EQUIPPED WITH VVR SYSTEM
   a. VEHICLE VAPOR RECOVERY SYSTEM
   b. VENT PIPE CONNECTED TO VAPOR TRAP
   c. TRAP CONDENSES VAPOR AND RETURNS IT TO FUEL TANK
   d. MAY HAVE VAPOR RETURN LINE FROM FUEL PUMP ESPECIALLY IF CAR IS AIR CONDITIONED

D. FUEL FILTER

1. KEEPS FOREIGN MATERIAL OUT OF FUEL PUMP AND CARBURETOR
2. SOME ARE LOCATED IN FUEL PUMP
3. FUEL TANK MAY HAVE INTERNAL FILTER
4. MOST HAVE FILTER ELEMENT IN GAS LINE
5. THOSE COMPOSED OF PAPER MUST BE CHANGED
6. OTHERS MADE OF SCREEN, CERAMIC, AND POROUS BRONZE MAY BE CLEANED AND REUSED

E. GAUGE UNITS

1. BALANCING COIL AND THERMOSTATIC TYPES OF FUEL GAUGES

2. BOTH HAVE A DASH UNIT AND TANK UNIT
3. EACH OPERATES ON BATTERY VOLTAGE THROUGH IGNITION SWITCH

1. THERMOSTATIC TYPE

1. THERMOSTAT BLADE ENCLOSED IN HEATING COIL FOR EACH UNIT
2. HEATING COILS WIRED IN SERIES

SHOW: TRANSPARENCY FIG. 558

3. FLOAT IN TANK UNIT OPERATES A CAM
4. CAM TURNS, CAUSING BEND IN THERMOSTAT BLADE
5. CURRENT FLOW HEATS COIL, CAUSING MORE BEND
6. EXCESSIVE BENDING SEPARATES CONTACTS, STOPPING CURRENT
7. THERMOSTAT BLADE COOLS, CLOSING POINTS AND PROCESS REPEATED
8. AMOUNT OF BEND OF TANK THERMOSTAT IS RELAYED TO DASH UNIT THERMOSTAT BLADE
9. DASH THERMOSTAT BENDS ACCORDINGLY AND OPERATES POINTER LINKAGE
10. TANK FULL - MORE CURRENT REQUIRED TO BREAK CONTACT, CAUSING MORE HEATING AND BENDING SO POINTER MOVES TO FULL SIDE OF GAUGE
11. TANK EMPTY - CAM IMPOSES LITTLE BEND SO SMALL AMOUNT OF CURRENT BREAKS CONTACTS AND DASH UNIT BLADE BENDS ONLY SLIGHTLY, CAUSING POINTER TO SHOW EMPTY

2. BALANCING COIL TYPE

1. ALSO CALLED ELECTROMAGNETIC GAUGE
2. HAS TWO MAGNETIC CIRCUITS WITH COILS TO PRODUCE MAGNETIC FIELDS

SHOW: TRANSPARENCY FIG. 559

3. MAGNETIC FIELDS ACT ON GAUGE POINTER
4. "EMPTY" COIL PRODUCES WEAK BUT CONSTANT FIELD ATTRACTING THE POINTER
5. TANK UNIT HAS SLIDING CONTACT WITH LENGTH OF RESISTOR

6. FLOAT SPECIFIES AMOUNT OF RESISTANCE IN CIRCUIT BY MOVING THE SLIDING CONTACT
7. LOWERING FUEL LEVEL REDUCES CIRCUIT RESISTANCE
8. STRONGER MAGNETIC FIELD PRODUCED IN "FULL" COIL AS FLOAT RISES, WEAKENS AS IT DROPS
9. MARKS ON DASH GAUGE APPROXIMATE FUEL LEVEL

F. FUEL LINE

1. USUALLY COMPOSED OF DURABLE STEEL TUBING
2. CLIPS ATTACH TO FRAME FOR SUPPORT AND PROTECTION
3. SEGMENTS CONNECTED BY HOSE IN VARIOUS PLACES MAY BE USED TO PROVIDE FLEXIBILITY
4. CONNECT FUEL TANK TO FUEL PUMP THEN TO CARBURETOR
5. BROKEN, DENTED, OR CORRODED SEGMENTS REPLACED WITH NEW TUBING OR HOSE
6. SHOULD BE CLEANED WHEN TANKS ARE CLEANED

G. SERVICE CONSIDERATIONS

1. CLEANING OR OTHER WORK ON TANK MAY REQUIRE ITS REMOVAL
2. SHOULD BE COMPLETELY DRAINED OF FUEL
3. SOME TANKS HAVE DRAIN PLUG, BUT IF NOT:
   a. SIPHON MAKE OF 1/2 INCH RUBBER TUBING
   b. ONE END MADE HEAVY BY INSERTING STEEL NIPPLE
   c. SLIT IN HOSE NEAR OTHER END ALLOWS AIR GUN NOZZLE INSERTION
   d. BLOWING AIR TOWARD OPEN END CREATES VACUUM PULLING OUT FUEL

CAUTION: NEVER SIPHON A TANK BY STARTING A VACUUM BY MOUTH. GASOLINE IN THE LUNGS CAN CAUSE PNEUMONIA AND DEATH

5. SEVERE DENT IN TANK MAY BE REMOVED BY:
   a. REMOVING AND FILLING TO TOP WITH WATER
   b. WITH NONVENTED CAP ON FILLER NECK AND VENT LINE PLUGGED
   c. AIR IS INJECTED IN PICKUP LINE UNTIL DENT POPS OUT

   CAUTION: USING AIR ALONE CAN CAUSE THE TANK TO EXPLODE VIOLENTLY

6. BRAZING OR SOLDERING USED TO REPAIR LEAKS AFTER PROPER SAFETY MEASURES TAKEN
   a. TANK THOROUGHLY DRAINED AND STEAM CLEANED INSIDE AND OUT
   b. AFTER CLEANING, TANK FILLED WITH NONEXPLOSIVE GAS
      (1) CARBON DIOXIDE
      (2) NITROGEN
   c. TANK MAY ALSO BE FILLED WITH WATER AFTER CLEANING

   CAUTION: UNSAFE PRACTICES CAN TURN A GASOLINE TANK INTO A LETHAL BOMB CAPABLE OF KILLING OR MAIMING PEOPLE NEARBY

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK DISCUSSION QUESTIONS TO STRENGTHEN CONCEPTS PRESENTED IN THE LESSON AND EXPLAIN ANY QUESTIONS ARISING FROM THE READING ASSIGNMENT.

EXAMPLE: WHAT CHANGES HAVE TAKEN PLACE IN GASOLINE TANK VENTILATION SYSTEMS OVER THE YEARS?

ANSWER: TANKS WERE ONCE VENTED TO THE ATMOSPHERE, BUT CONCERN FOR AIR POLLUTION AND SMOG PROMPTED DEVELOPMENT OF A CLOSED VENT SYSTEM. THIS WAS THE VEHICLE VAPOR RECOVERY SYSTEM WHICH TRAPS THE VAPOR, TURNS IT BACK INTO LIQUID, AND RETURNS THE FUEL TO THE GASOLINE TANK.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

TRUE - FALSE TEST

1.	PROPANE REQUIRES A MUCH STRONGER TANK THAN GASOLINE.	T
2.	BAFFLES ATTACH THE TANK TO THE REAR OF THE FRAME.	F
3.	GASOLINE TANKS WERE VENTED TO THE ATMOSPHERE IN 1960.	T
4.	A VAPOR TRAP IS AN IMPORTANT PART OF THE VVR SYSTEM.	T
5.	PAPER, CERAMIC, AND BRONZE MAY BE USED TO MAKE FUEL FILTERS.	T
6.	BALANCING COIL AND THERMOSTATIC ARE TERMS USED TO DESCRIBE VENTILATION SYSTEMS.	F
7.	ELECTROMAGNETIC IS ANOTHER NAME FOR A THERMOSTATIC FUEL GAUGE.	F
8.	A BALANCING COIL AND A HEATING COIL OPERATE ON THE SAME PRINCIPLE IN DIFFERENT TYPES OF GAUGES.	F
9.	PNEUMONIA AND DEATH CAN RESULT FROM GASOLINE IN THE LUNGS.	T
10.	NITROGEN IS A GAS THAT WILL NOT EXPLODE.	T

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

FUEL TANKS VARY IN SIZE AND DESIGN DEPENDING UPON THE VEHICLE AND TYPE OF FUEL IT WILL CONTAIN. THEY ARE USUALLY LOCATED IN THE REAR OF THE FRAMEWORK WHERE THERE IS MAXIMUM PROTECTION AND CONNECTED TO THE FUEL PUMP BY STEEL TUBING.

THE VENTILATION SYSTEM ON OLDER MODELS ALLOWED GASOLINE FUMES TO ESCAPE INTO THE AIR, BUT SINCE THIS CONTRIBUTED TO SMOG CARS NOW HAVE THE VVR SYSTEM THAT RETURNS GAS VAPORS TO THE FUEL TANK.

FOREIGN MATERIAL SUCH AS DIRT AND RUST CAN RUIN THE OPERATING EFFICIENCY OF THE FUEL PUMP AND CARBURETOR. MOST VEHICLES HAVE ONE OR MORE FILTERS OF VARIOUS TYPES TO CLEAN THE FUEL BEFORE IT REACHES THEM.

THERE ARE TWO TYPES OF FUEL GAUGES: BALANCING COIL AND THERMOSTATIC. BOTH OPERATE ON BATTERY CURRENT THROUGH THE IGNITION SWITCH. THE THERMOSTAT TYPE OPERATES ON THE PRINCIPLE OF HEATING

COILS BENDING BLADES WHICH OPEN AND CLOSE POINTS. THIS CAUSES THE POINTER TO RISE OR FALL. BALANCING COIL GAUGES WORK ON VARIANCE OF MAGNETIC FIELDS PRODUCED BY COILS ON EITHER SIDE OF THE GAUGE POINTER. THE POSITION OF THE TANK FLOAT IS RELAYED TO THE DASH UNIT IN BOTH TYPES.

FUEL LINES ARE RELATIVELY TROUBLE FREE EXCEPT FOR CLEANING WHEN FOULED AND CHANGING THE FILTER PERIODICALLY.

VARIOUS SERVICE PROCEDURES ARE DISCUSSED INCLUDING DRAINING, CLEANING, SOLDERING, AND SEVERE DENT REMOVAL. THE DANGERS INVOLVED IN WORKING WITH GASOLINE AND GASOLINE TANKS CANNOT BE OVERLY STRESSED.

SUGGESTED READING FOR THE STUDENT:

AUTOMECHANICS, GLENN, CH. 6

NEXT LESSON IS: VII-C-1(I), "FUEL PUMP"

INSTRUCTOR'S PLAN VII-B-1(S)
MANIPULATIVE LESSON

TASK:	SERVICE FUEL TANK FOR 1975 FORD AND MERCURY
AIM:	STUDENTS WILL BE ABLE TO SAFELY REMOVE, CLEAN OUT, REINSTALL, OR REPLACE FUEL TANK AND COMPONENT PARTS. STUDENT WILL BE ABLE TO DIAGNOSE FUEL TANK PROBLEMS
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SIPHON HOSE, CLOSED CONTAINER, FLOOR JACK, 4 JACK STANDS OR FLOOR LIFT, FIRE EXTINGUISHER, STEAM CLEANER
MATERIALS:	CLEAN RAGS AND "SORB ALL" FLOOR CLEANER
TEACHING AIDS:	TRANSPARENCIES: I ED. II 7 T FIGS. 556, 557, 558, 559
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE LEARNER MUST HAVE KNOWLEDGE OF DANGER INVOLVED WHILE WORKING WITH GASOLINE. THE LEARNER MUST KNOW HOW TO USE FIRE FIGHTING EQUIPMENT THE LEARNER MUST BE ABLE TO BRAZE WITH ACETYLENE OXYGEN TORCH
REFERENCES:	AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-1 TO 20-3 MANUFACTURER'S INSTRUCTION MANUAL OF CAR AT HAND
CHECKING STANDARDS:	1. OBSERVATION OF SAFETY STANDARDS 2. PROPER TOOLS AND USE 3. FOLLOWS DIRECTIONS 4. COMPLETION OF TASK TO PRESCRIBED OBJECTIVES

I. PREPARATION (OF THE LEARNER - MOTIVATION)

THE FUEL TANK HAS TO BE REMOVED TO:

1. CLEAN OUT CORROSION AND TRASH
2. REPAIR LEAKS
3. REPAIR FUEL GAUGE SENDING UNIT (SOME MAKES AND MODELS)

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. DEMONSTRATE	1. PERFORM ALL STEPS 2. MAKE ALL KEY POINTS CLEAR AND PRECISE

3. EMPHASIZE SAFETY

2. PERFORM VEHICLE SAFETY
   1. DISCONNECT STORAGE BATTERY
      a. PREVENT ACCIDENTAL STARTING OF ENGINE
      b. ELIMINATE ELECTRICAL SHORTS
      NOTE: STRESS CARE IN REMOVAL OF BATTERY CABLES
   2. USE BATTERY PLIERS
      NOTE: IF NECESSARY USE TERMINAL PULLER TO REMOVE BATTERY CABLES
      a. REMOVE GROUND CABLE FIRST TO ELIMINATE SPARKS
      b. REMOVE POSITIVE CABLE LAST
   3. SET FOOT OR HAND BRAKE IN VEHICLE

3. RAISE FRONT OF VEHICLE
   1. POSITION JACK RAM DIRECTLY UNDER FRAME OR CROSSMEMBERS
   2. ALIGN FOR PROPER BALANCE
      CAUTION: MAKE SURE JACK IS PROPERLY ALIGNED UNDER FRAME OR CROSSMEMBERS
      CAUTION: MAKE SURE JACK RAM IS IN FIRM CONTACT WITH FRAME
   3. BLOCK REAR WHEELS
   4. RAISE TO MAXIMUM HEIGHT

4. LOWER VEHICLE ON STANDS
   1. POSITION STANDS UNDER FRAME ON BOTH SIDES OF CAR
   2. LOWER VEHICLE TO STANDS
      CAUTION: MAKE SURE FRAME IS ON STAND AND STANDS ARE SQUARE WITH FLOOR
   3. REMOVE JACK

5. RAISE REAR OF VEHICLE
   1. POSITION JACK
      NOTE: BE SURE JACK IS PROPERLY ALIGNED UNDER DIFFERENTIAL
   2. RAISE HIGH ENOUGH TO LEVEL VEHICLE
   3. POSITION JACK STANDS UNDER AXLE HOUSING
   4. LOWER VEHICLE TO STANDS
      CAUTION: MAKE SURE AXLE HOUSING IS STRAIGHT ON STANDS AND THE STANDS ARE SQUARE WITH FLOOR

6.	MAKE SAFETY INSPECTION	1. INSPECT FOR OPEN FLAMES IN THE SHOP 2. OPEN ALL WINDOWS AND DOORS 3. TURN ON FANS IF AVAILABLE
7.	REMOVE GAS FROM TANK	1. SIPHON OR PUMP OUT GASOLINE FROM MAIN AND AUXILIARY FUEL TANKS 2. DRAIN INTO SAFE GAS CONTAINER 3. DISCONNECT AUXILIARY TANK FROM MAIN TANK DRAIN HOSE CAUTION: CARE SHOULD BE TAKEN TO PREVENT SPILLAGE SHOULD TANK NOT BE COMPLETELY DRAINED
8.	REMOVE TANK	1. REMOVE VAPOR LINE FROM FUEL TANK 2. DISCONNECT MAIN SUPPLY LINE 3. DISPLACE HOSE CLAMPS NOTE: USE PLIERS 4. DISCONNECT GROUND CABLES AND CABLE AND GAUGE WIRE 5. REMOVE FILLER NECK RETAINING SCREW NOTE: USE PROPER SIZE SCREWDRIVER 6. REMOVE FILLER NECK BY PULLING FROM TANK 7. UNSCREW TANK SUPPORT STRAP NUTS NOTE: USE PROPER SOCKET 8. SUPPORT TANK AND LOWER TO THE FLOOR 9. REMOVE GAUGE UNIT 10. TURN OUT LOCK RING 11. DISCARD SEAL
9.	CLEAN AND INSPECT	1. LOCATE TANK AWAY FROM FLAME, HEAT, OR ANY OTHER SOURCE OF IGNITION 2. COMPLETE DRAINING OF TANK BY ROCKING AND ALLOW FUEL TO RUN OUT UNIT HOLE 3. PURGE TANK WITH STEAM OR RUNNING HOT WATER AT LEAST FIVE MINUTES WARNING: THIS PROCEDURE WILL NOT REMOVE ALL FUEL VAPOR. DO NOT ATTEMPT ANY REPAIR ON TANK OR FILLER NECK WHERE HEAT OR OPEN FLAME IS REQUIRED

10.	INSTALL FUEL TANK	1. INSTALL FUEL GAUGE UNIT, USE NEW SEAL 2. POSITION TANK IN PLACE 3. INSTALL FUEL TANK SUPPORT STRAPS 4. INSTALL NUTS ON STRAP BOLTS 5. CONNECT VAPOR LINE TO FUEL TANK 6. CONNECT MAIN FUEL SUPPLY LINE TO FITTING 7. MOVE CLAMP INTO PLACE 8. CONNECT GROUND STRAP AND GAUGE WIRE 9. INSTALL GAS FILLER PIPE 10. INSTALL ATTACHING SCREW 11. SIPHON OR PUMP GASOLINE INTO TANK
11.	REMOVE VEHICLE FROM STANDS	1. PLACE JACK RAM UNDER DIFFERENTIAL CAUTION: BE SURE JACK RAM IS SQUARE UNDER DIFFERENTIAL AND LIFTS VEHICLE STRAIGHT UP 2. RAISE VEHICLE UNTIL JACK STANDS ARE CLEAR 3. REMOVE JACK STANDS AND PLACE IN STORAGE 4. LOWER VEHICLE 5. REVOME JACK 6. POSITION JACK UNDER CROSSMEMBER OR FRAME IN FRONT CAUTION: MAKE SURE JACK RAM IS SQUARE WITH AND IN CENTER OF CROSSMEMBER OR FRAME 7. LIFT VEHICLE TO CLEAR JACK STANDS 8. REMOVE JACK STANDS AND PLACE IN STORAGE 9. LOWER VEHICLE TO FLOOR 10. REMOVE JACK AND PLACE IN STORAGE
12.	REMOVE VEHICLE	1. REMOVE VEHICLE FROM STALL 2. PLACE IN PARKING AREA
13.	CLEAN WORK STATION	1. CLEAN TOOLS AND RETURN TO STORAGE 2. RETURN EQUIPMENT TO STORAGE 3. SWEEP WORK STATION

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. STUDENTS TO REPEAT ALL STEPS OF THE TASK.

III. APPLICATION (CON'T.) VII-B-1(S)

2. STUDENTS TO POINT OUT SAFETY AND HAZARD PRECAUTIONS.

3. CHECK STUDENTS FOR KEY POINTS.

4. STUDENTS TO PRACTICE ON TASK.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

PUT STUDENTS ON THEIR OWN TO PERFORM TASK (PERFORMANCE TEST)

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. REPEAT STEPS FROM STAGE II.

2. EMPHASIZE SAFETY AND CAUTIONS OF KEY POINTS IN STAGE II.

3. REEMPHASIZE PERTINENT KEY POINTS FROM STAGE II.

4. EMPHASIZE CHECKING STANDARDS FOR THE TASK.

SUGGESTED READING FOR STUDENTS:

AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-1 TO 20-3
MANUFACTURER'S REPAIR MANUAL OF VEHICLE AT HAND

THE NEXT LESSON IS: VII-C-1(S) "REMOVE AND REPLACE FUEL PUMP"

JOB SHEET
IN
FUEL SYSTEM

VII-B-1(J)

JOB:	SERVICE FUEL TANK	
MATERIALS:	CLEAN RAGS, "SORB ALL", LAUNDRY SOAP	
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, STEAM CLEANER, FLOOR JACK, 4 JACK STANDS OR FLOOR LIFT, SIPHON HOSE OR PUMP, SAFETY GAS CAN	
GENERAL INSTRUCTIONS:	BEFORE DOING THIS JOB STUDENTS MUST REVIEW SAFETY RULES TO HANDLE GASOLINE	
PROCEDURES AND/OR TASKS:	VII-B-1(TS)	PERFORM VEHICLE SAFETY
	VII-B-1a(TS)	PLACE VEHICLE ON STANDS
	VII-B-1b(TS)	REMOVE FUEL TANK
	VII-B-1c(TS)	CLEAN AND INSPECT FUEL TANK
	VII-B-1d(TS)	INSTALL MAIN FUEL TANK
	VII-B-1e(TS)	REMOVE VEHICLE FROM JACK STANDS
	VII-B-1f(TS)	MAKE VEHICLE READY
	VII-B-1g(TS)	CLEAN WORK STATION

CHECK POINTS:

1. OBSERVE SAFETY RULES AND SHOP POLICIES AND REGULATIONS
2. USE TOOLS IN PROFESSIONAL AND CRAFTSMANLIKE MANNER
3. TAKE MENTAL NOTES OF ALL NEW TASKS AT HAND

TASK SHEET VII-B-1(TS)

TASK: PERFORM VEHICLE SAFETY

JOB: SERVICE FUEL TANK

TRADE: AUTO MECHANICS

TOOLS AND MATERIALS: BATTERY PLIERS, BATTERY CABLE TERMINALS, PULLER, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. CAREFULLY DRIVE VEHICLE IN WORK STALL 2. CUT OFF ENGINE 3. REMOVE IGNITION KEY NOTE: GIVE KEY TO INSTRUCTOR FOR PROPER FILING
2. DISCONNECT STORAGE BATTERY A. PREVENTS ACCIDENTAL STARTING OF ENGINE B. ELIMINATES ELECTRICAL SHORTS	1. RAISE HOOD NOTE: SUPPORT HOOD WITH SUPPORT ROD IF APPLICABLE TO VEHICLE 2. LOOSEN GROUND CABLE AND REMOVE NOTE: TO PREVENT ACCIDENTAL SHORTS WHILE REMOVING CABLES 3. DISCONNECT POSITIVE CABLE

TASK SHEET VII-B-1a(TS)

TASK: PLACE VEHICLE ON STANDS

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: FLOOR JACK, 4 JACK STANDS OR FLOOR LIFT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION FLOOR JACK UNDER VEHICLE	1. SET JACK RAM DIRECTLY UNDER THE FRAME OR CROSSMEMBER 2. ALIGN JACK RAM FOR PROPER WEIGHT DISTRIBUTION a. PLACE JACK IN CENTER OF CROSS-MEMBER b. PLACE JACK RAM ON FLAT PART OF FRAME OR CROSSMEMBER 3. HAVE OBSERVING PERSONS STAND CLEAR
2. RAISE FRONT END OF VEHICLE	1. BLOCK REAR WHEELS a. PLACE WHEEL BLOCKS BEHIND REAR WHEELS b. PLACE BLOCK IN CONTACT WITH REAR WHEEL 2. TURN JACK FLUID RELEASE VALVE TO RIGHT (CLOCKWISE) a. TURN UNTIL SNUG TIGHT b. ACTIVATES THE JACK HYDRAULIC PRESSURE 3. MOVE JACK HANDLE UP AND DOWN UNTIL JACK RAM CONTACTS FRAME OR CROSSMEMBER a. CHECK TO MAKE SURE RAM IS IN GOOD CONTACT WITH FRAME OR CROSSMEMBER b. IF THE JACK NEEDS TO BE MOVED TURN RELEASE VALVE TO LEFT (COUNTERCLOCKWISE) AND RE-ADJUST JACK POSITION 4. MOVE THE JACK UP AND DOWN (HERE-AFTER STATED PUMP THE JACK HAN-DLE) UNTIL JACK RAM REACHES ITS

STEPS	KEY POINTS
	MAXIMUM HEIGHT
4. LOWER FRONT END OF VEHICLE ON STANDS	1. POSITION SAFETY STANDS UNDER FRAME DIRECTLY BEHIND FRONT WHEELS 2. RAISE STAND EXTENSIONS AS HIGH AS POSSIBLE a. CHECK AND MAKE SURE STAND EXTENSION LOCK IS SECURELY IN PLACE b. VISUALLY CHECK TO MAKE SURE STANDS ARE DIRECTLY UNDER FRAME AND STANDS ARE SQUARE WITH FLOOR 3. TURN JACK RELEASE VALVE TO LEFT CAUTION: TURN RELEASE VALVE SLOWLY NOTE: MAKE SURE FRAME RESTS SQUARELY ON JACK STANDS 4. REMOVE JACK
5. RAISE REAR END OF VEHICLE	1. SET JACK RAM UNDER FRAME OR CROSSMEMBER 2. ALIGN JACK FOR PROPER WEIGHT DISTRIBUTION NOTE: PLACE JACK IN CENTER OF CROSSMEMBER NOTE: PLACE JACK RAM UNDER FRAME ON FLAT PART OF FRAME 3. TURN JACK FLUID RELEASE VALVE TO THE RIGHT 4. PUMP JACK HANDLE UNTIL JACK RAM CONTACTS FRAME OR CROSSMEMBER NOTE: CHECK TO MAKE SURE RAM IS IN GOOD CONTACT WITH FRAME OR CROSSMEMBER NOTE: IF THE JACK NEEDS TO BE MOVED TURN RELEASE VALVE TO LEFT AND ADJUST JACK POSITION THEN RETIGHTEN FLUID RELEASE VALVE 5. PUMP JACK HANDLE UNTIL JACK RAM REACHES ITS MAXIMUM HEIGHT
6. LOWER REAR OF VEHICLE ON STANDS	1. POSITION STANDS UNDER FRAME DIRECTLY BEHIND REAR WHEELS 2. RAISE STAND EXTENSIONS AS HIGH AS POSSIBLE

STEPS	KEY POINTS
	CAUTION: CHECK AND MAKE SURE STAND EXTENSION LOCK IS SECURELY IN PLACE NOTE: VISUALLY CHECK TO MAKE SURE STANDS ARE DIRECTLY UNDER FRAME AND STANDS ARE SQUARE WITH FLOOR
3. TURN JACK RELEASE VALVE TO LEFT (COUNTERCLOCKWISE)	CAUTION: BE VERY CAREFUL TO TURN RELEASE VALVE SLOWLY NOTE: MAKE SURE THE FRAME RESTS SQUARELY ON STANDS
4. REMOVE JACK AND RETURN TO STORAGE	

TASK: REMOVE FUEL TANK

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND EQUIPMENT: BASIC HAND TOOLS, SAFETY GOGGLES, DROP LIGHT, SIPHON HOSE OR GASOLINE PUMP, SAFETY CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE GASOLINE FROM TANK	CAUTION: MAKE SURE THERE ARE NO OPEN FLAMES IN SHOP 1. SIPHON OR PUMP OUT GASOLINE FROM TANK CAUTION: CARE SHOULD BE TAKEN TO PREVENT SPILLAGE SHOULD TANK NOT BE COMPLETELY DRAINED
2. DISCONNECT MAIN SUPPLY LINE	1. USE PLIERS TO MOVE HOSE CLAMP TO CENTER OF HOSE 2. TWIST AND PULL HOSE OFF FITTING
3. DISCONNECT GROUND CABLE AND GAUGE WIRE	1. USE PLIERS TO UNFASTEN GROUND WIRE CLIPS 2. PULL GAUGE WIRE OFF OF FITTING
4. REMOVE FILLER NECK	1. REMOVE RETAINING SCREW a. USE PROPER SIZE SCREWDRIVER b. TURN TO LEFT (COUNTERCLOCKWISE) c. PLACE SCREWS IN CONTAINER 2. PULL FILLER TUBE OUT OF TANK
5. DISCONNECT TANK SUPPORT STRAPS	1. UNSCREW TANK SUPPORT STRAP NUTS a. USE PROPER SOCKET AND RATCHET b. TURN NUTS TO LEFT (COUNTERCLOCKWISE) c. PLACE NUTS IN CONTAINER 2. SUPPORT TANK AND REMOVE STRAPS 3. LOWER TANK TO FLOOR
6. REMOVE GAUGE UNIT	1. TURN LOCKING RING TO LEFT 2. LIFT OUT GAUGE 3. DISCARD SEAL

TASK SHEET VII-B-1c(TS)

TASK: CLEAN AND INSPECT FUEL TANK

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: SCRAPER, SAFETY GOGGLES, STEAM CLEANER, HOT WATER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE OUTSIDE DIRT	1. SCRAPE OFF EXCESS WITH SCRAPER 2. WASH WITH SOLVENT BRUSH
2. REMOVE FUMES AND VAPORS	1. WASH WITH RUNNING HOT WATER FOR FIVE MINUTES 2. STEAM CLEAN INSIDE AND OUT FOR AT LEAST FIVE MINUTES
3. CHECK FOR HOLES OR CRACKS	1. VISUALLY INSPECT OUTSIDE FOR ANY LEAK 2. MARK THE DAMAGED SPOT CLEARLY

TASK: INSTALL MAIN FUEL TANK

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, CLEAN RAGS, SAFETY GOGGLES, DROP LIGHT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL FUEL GAUGE	1. POSITION FUEL GAUGE WITH NEW SEAL 2. INSTALL LOCKING RING a. USE PROPER SCREWDRIVER b. TURN LOCKING RING TO RIGHT (CLOCKWISE) c. TURN UNTIL AGAINST STOPS
2. POSITION TANK	1. RAISE TANK INTO PLACE 2. INSTALL RETAINER STRAPS 3. INSTALL RETAINER STRAP NUTS a. USE PROPER SOCKET AND RATCHET b. TURN NUTS TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS 4. PUSH VAPOR LINE ONTO TANK FITTING 5. PUSH MAIN FUEL LINE ONTO FITTING 6. SECURE WITH CLAMP a. USE PLIERS b. MOVE CLAMP INTO PROPER LOCATION 7. CLAMP GROUND WIRE ONTO GAUGE UNIT 8. PLUG ON GAUGE WIRE
3. INSTALL FILLER PIPE	1. PUSH FILLER PIPE INTO PLACE USING NEW SEAL 2. INSTALL RETAINING SCREW a. USE PROPER SCREWDRIVER b. TURN SCREW TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS 3. SIPHON OR PUMP IN GASOLINE 4. REPLACE GAS TANK CAP

TASK: REMOVE VEHICLE FROM JACK STANDS

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANIC

TOOLS AND MATERIALS: FLOOR JACK, 4 JACK STANDS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LOWER REAR OF VEHICLE	1. PLACE JACK RAM UNDER DIFFERENTIAL CAUTION: BE SURE JACK RAM IS SQUARE UNDER DIFFERENTIAL AND LIFTS VEHICLE STRAIGHT UP 2. RAISE VEHICLE UNTIL JACK STANDS ARE CLEAR 3. REMOVE JACK STANDS AND PLACE IN STORAGE 4. LOWER VEHICLE 5. REMOVE JACK
2. LOWER FRONT OF VEHICLE	1. POSITION JACK RAM UNDER FRONT OF VEHICLE ON FRAME OR CROSSMEMBER CAUTION: MAKE SURE JACK IS IN FIRM CONTACT WITH FRAME OR CROSSMEMBER AT CENTER AND ON FLAT PART 2. LIFT VEHICLE TO CLEAR STANDS 3. REMOVE STANDS AND PLACE IN STORAGE 4. LOWER VEHICLE TO FLOOR 5. REMOVE JACK AND PLACE IN STORAGE

TASK: MAKE VEHICLE READY

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BATTERY PLIERS, CLEAN RAGS

TASK BREAKDOWN:

1. CONNECT BATTERY	1. CONNECT POSITIVE BATTERY CABLE a. USE BATTERY PLIERS b. TURN NUT TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS 2. CONNECT BATTERY GROUND CABLE a. USE BATTERY PLIERS b. TURN NUT TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS 3. REMOVE ALL TOOLS FROM VEHICLE 4. START ENGINE, CHECK FOR LEAKS 5. REPAIR LEAKS IF ANY 6. CLOSE HOOD 7. TURN IGNITION OFF

TASK SHEET VII-B-1g(TS)

TASK: CLEAN WORK STATION

JOB: SERVICE FUEL TANK

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEAN RAGS, FLOOR BROOM, DUST PAN

TASK BREAKDOWN:

1. REMOVE VEHICLE	1. REMOVE VEHICLE FROM STALL 2. PLACE IN PARKING AREA
2. CLEAN WORK STATION	1. CLEAN TOOLS AND RETURN TO STORAGE 2. RETURN EQUIPMENT TO STORAGE 3. SWEEP WORK STATION 4. PICK UP RESIDUE AND PLACE IN TRASH CAN 5. RETURN CLEANING TOOLS TO STORAGE

INSTRUCTOR'S PLAN VII-C-1(I)
INFORMATIONAL LESSON

SUBJECT:	FUEL PUMP
AIM:	THE STUDENT WILL BE ABLE TO COMPARE TYPES OF FUEL PUMPS AND DESCRIBE THEIR COMPONENTS AND OPERATION.
TEACHING AIDS:	TRANSPARENCIES I, ED. II 7T, FIGS. 556 AND 560 USED FUEL PUMPS CHALKBOARD
MATERIALS:	CHALK
REFERENCES:	AUTOMOTIVE MECHANICS, CROUSE, CHS. 9 AND 20 AUTOMECHANICS, GLENN, CH. 6 AUTO SERVICE AND REPAIR, STOCKEL, CH. 20 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 255-270
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE STUDENT SHOULD HAVE SATISFACTORILY COMPLETED THE LESSON ON FUEL TANKS.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

SEVERAL METHODS HAVE BEEN TRIED IN SUPPLYING AUTOMOTIVE ENGINES WITH THE NECESSARY QUANTITY OF FUEL. THE FIRST USED GRAVITY AND ATMOSPHERIC PRESSURE BUT THIS WAS DISCARDED. IT PROVIDED TOO LITTLE FUEL ON STEEP HILLS AND WAS DANGEROUS BECAUSE IT REQUIRED PLACING THE TANK ABOVE AND RELATIVELY CLOSE TO THE ENGINE. NEXT, PRESSURIZED FUEL TANKS WERE USED. THEY WERE TOO COMPLEX TO BE VERY PRACTICAL AND REQUIRED AN AIR TIGHT TANK. THE DEVELOPMENT OF A DEVICE THAT PULLED FUEL FROM THE TANK AND PUSHED IT INTO THE CARBURETOR AS IT WAS NEEDED SOLVED THE PROBLEM. THIS DEVICE IS THE SUBJECT OF OUR LESSON TODAY: THE FUEL PUMP.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. FUNCTION OF FUEL PUMP	1. PURPOSE IS TO SUPPLY FUEL TO CARBURETOR a. PULLS IN FUEL FROM TANK BY VACUUM b. PUSHES FUEL OUT UNDER PRESSURE

2. KEEPS CARBURETOR RESERVOIR FULL
   a. NEEDLE VALVE AND FLOAT CONTROL LEVEL OF FUEL
   b. PUMPING ACTION STOPS WHEN VALVE CLOSES

B. TYPES

1. ELECTRIC FUEL PUMPS ON HEAVY DUTY VEHICLES
   a. TRUCKS AND BUSES MAY HAVE THIS TYPE
   b. SOME ARE LOCATED INSIDE FUEL TANK

SHOW: TRANSPARENCY FIG. 560

   c. ELECTRIC MOTOR OPERATES ON BATTERY CURRENT
   d. PUMPING MECHANISM IS VARIABLE
      (1) PLUNGER MAY PRODUCE PRESSURE
      (2) IMPELLER SPINS FORCING THE FUEL OUT
      (3) BELLOWS DESIGN GIVES CONSTANT PRESSURE
      (4) DIAPHRAGM TYPE SIMILAR TO MECHANICAL PUMP
   e. SAME BASIC OPERATION AS MECHANICAL TYPE
2. MECHANICAL FUEL PUMP MOST COMMON ON CARS
   a. DESIGN IS SOMEWHAT VARIABLE
   b. ALL FUNCTION IN THE SAME MANNER
   c. OLDER TYPES HAD VACUUM BOOSTER FOR WINDSHIELD WIPER
   d. COMBINATION TYPE PUMPED BOTH FUEL AND AIR

C. CONSTRUCTION OF MECHANICAL TYPE

1. PUMP HOUSING OR BODY MADE OF LIGHT WEIGHT METAL
   a. HOUSING HALVES MAY OVERLAP AND CRIMP TOGETHER
   b. THIS TYPE CANNOT BE REPAIRED AND MUST BE REPLACED WHEN DEFECTIVE
   c. THOSE BOLTING TOGETHER ARE USUALLY REPAIRABLE

2. ROCKER ARM ASSEMBLY
   a. ATTACHED IN HOUSING BY PIVOT PIN
   b. LONGER END EXTENDS OUT OF HOUSING
   c. RIDES ON ECCENTRIC OF CAM SHAFT OR A PUSH ROD
   d. INNER END ATTACHES TO PULL ROD
   e. FLEXIBLE DIAPHRAGM ATTACHED TO END OF PULL ROD
   f. ROCKER ARM RETURN SPRING INSIDE HOUSING
3. DIAPHRAGM ASSEMBLY
   a. COMPOSED OF FLEXIBLE MATERIAL
   b. OUTER EDGE CLAMPED BETWEEN HOUSING HALVES
   c. CENTER PORTION HELD BETWEEN PLATES
   d. PLATES ATTACH TO PULL ROD
   e. SPRING PUSHES AGAINST DIAPHRAGM BOTTOM
4. FUEL PUMP CHAMBER USUALLY LOCATED ABOVE THE DIAPHRAGM
5. VALVE ASSEMBLY
   a. INLET VALVE ON TANK LINE SIDE OF PUMP
   b. OUTLET VALVE ON CARBURETOR SIDE
   c. THREADED HOUSING ALLOWS LINE ATTACHMENT TO EACH VALVE CHAMBER
   d. SPECIAL OUTLET FOR VAPOR RETURN LINE ON SOME
6. MAY HAVE PULSATOR DIAPHRAGM TO REDUCE SURGES
7. FUEL COVER ABOVE PULSATOR COMPLETES UNIT

D. FUEL PUMP FILTERS

1. SOME CONSTRUCTED WITH REPLACEABLE FILTERS ON OUTSIDE
2. SEDIMENT BOWL AND SCREEN WAS ONCE POPULAR
3. VARIOUS TYPES OF INTERNAL FILTERS STILL USED

E. PUMP LOCATION

SHOW: TRANSPARENCY FIG. 556

1. MOUNTS ON SIDE OF IN-LINE ENGINES
   a. OPENING PROVIDED IN CYLINDER BLOCK
   b. ROCKER ARM EXTENDS INSIDE
   c. PUMP HOUSING BOLTS TO BLOCK
2. LOCATION VARIABLE ON V-8 ENGINES
   a. MAY MOUNT BETWEEN CYLINDER BANKS
   b. MOST MOUNT ON SIDE NEAR FRONT

F. OPERATION

1. ECCENTRIC ON CAMSHAFT DRIVES ROCKER ARM
2. PUSH ROD BETWEEN ECCENTRIC AND ROCKER ARM WHERE PUMP CENTRALLY MOUNTED ON V-8
3. ECCENTRIC TURNS CAUSING BACK AND FORTH MOVEMENT OF ROCKER ARM
4. SPRING ON ROCKER ARM KEEPS IT IN CONTACT WITH ECCENTRIC
5. LINKAGE CONNECTS ROCKER ARM TO DIAPHRAGM
6. SPRING LOADED DIAPHRAGM TRIES TO STAY IN UP POSITION
7. DIAPHRAGM PULLED DOWN BY ROCKER ARM
8. VACUUM CREATED IN PUMP CHAMBER
9. INLET VALVE FORCED OPEN BY VACUUM
10. ATMOSPHERIC PRESSURE PUSHES FUEL INTO CHAMBER
11. HIGH POINT OF ECCENTRIC ROTATES AWAY FROM ROCKER ARM
12. ROCKER ARM RELEASES DIAPHRAGM
13. SPRING UNDER DIAPHRAGM PUSHES IT UPWARD
14. SEVERAL POUNDS PRESSURE EXERTED ON CHAMBER
15. INLET VALVE CLOSES AND OUTLET VALVE OPENS
16. FUEL FORCED OUT INTO LINE TO CARBURETOR
17. CARBURETOR RESERVOIR TAKES IN FUEL
18. FLOAT AND NEEDLE VALVE CUT OFF FLOW WHEN FULL

19. CARBURETOR RESERVOIR TAKES IN FUEL
20. FLOAT AND NEEDLE VALVE CUT OFF FLOW WHEN FULL
21. FUEL PUMP CEASES DIAPHRAGM ACTION
22. ROCKER ARM CONTINUES TO OPERATE FUEL FLOWS AGAIN WHEN NEEDLE VALVE OPENS

G. MALFUNCTIONS

1. WEAR MAY CAUSE INTERNAL MALFUNCTION IN THESE PLACES:
   a. VALVES OR VALVE SEATS
   b. PULL ROD AND CONNECTIONS
   c. PUNCTURED OR SPLIT DIAPHRAGM
   d. WORN LINKAGE OR PIVOT PIN
2. FLEXIBLE LINES AND CONNECTIONS MAY LEAK OR SWELL INTERNALLY TO OBSTRUCT FLOW
3. MAY CAUSE CARBURETOR FLOODING BY EXCESSIVE PRESSURES DUE TO TOO RIGID DIAPHRAGM
4. VAPOR LOCK COMMON IN AIR CONDITIONED VEHICLES DUE TO HEATING

H. TESTS

1. VOLUME TESTS CHECK PUMP EFFICIENCY
   a. CRANKING SPEED TEST
      (1) LINE INTO CARBURETOR DISCONNECTED
      (2) FUEL DIRECTED INTO SMALL CONTAINER
      (3) ENGINE CRANKED WITH IGNITION OFF
      (4) PUMP SHOULD YIELD STRONG SPURTS OF FUEL
   b. IDLE SPEED PUMP TEST
      (1) CARBURETOR RESERVE BOWL FILLED
      (2) RESERVOIR FILL UP LINE DISCONNECTED
      (3) FLOW DIRECTED INTO PINT OR QUART CONTAINER
      (4) IDLE SPEED SHOULD PUMP A PINT IN ABOUT 45 SECONDS

2. PRESSURE GAUGE USED TO TEST PUMP
   a. GAUGE CONNECTED TO PUMP OUTLET
   b. CRANKING ENGINE SHOULD PRODUCE 3 TO 5 POUNDS PRESSURE
3. GAUGE USED TO TEST VACUUM SIDE
   a. VACUUM GAUGE CONNECTED TO PUMP INLET
   b. ENGINE OPERATED AT IDLE SPEED
   c. VACUUM SHOULD BE AT LEAST 10 INCHES

CAUTION: EXTREME CARE SHOULD BE TAKEN WHEN RUNNING AN ENGINE WHILE ALLOWING GASOLINE TO FLOW INTO AN OPEN CONTAINER

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

QUESTION STUDENTS ORALLY TO CHECK COMPREHENSION AND STIMULATE DISCUSSION OF THE MATERIAL PRESENTED.

BLANK OUT THE LABELS ON A FUEL PUMP TRANSPARENCY AND, WHILE SHOWING IT ON THE SCREEN, HAVE STUDENTS NAME THE COMPONENTS AND TELL HOW THEY FUNCTION.

HAVE STUDENTS LOCATE THE FUEL PUMPS ON VEHICLES IN THE IMMEDIATE AREA AND GIVE ANY PERTINENT INFORMATION THEY MIGHT KNOW.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

QUESTIONS: SIMPLE RECALL

1. THE PUMP PULLS FUEL INTO THE CHAMBER BY CREATING A ____. — VACUUM
2. FUEL LEVEL IN THE CARBURETOR IS CONTROLLED BY A ____ VALVE. — NEEDLE
3. THE VALVE MENTIONED IN NUMBER TWO IS OPERATED BY A ____ MECHANISM. — FLOAT
4. THERE ARE BASICALLY TWO TYPES OF FUEL PUMPS. THEY ARE EITHER ____ OR ____. — MECHANICAL, ELECTRICAL

5.	THE DIAPHRAGM OF A PUMP IS MADE OF ____ MATERIAL.	FLEXIBLE
6.	A ROCKER ARM IS HELD IN THE PUMP HOUSING BY A ____.	PIVOT PIN
7.	VACUUM IN THE PUMP CHAMBER OPENS THE ____ VALVE.	INLET
8.	ACTION OF THE DIAPHRAGM SPRING OPENS THE ____ VALVE.	OUTLET
9.	A ____ DIAPHRAGM MAY BE USED TO REDUCE FUEL SURGES.	PULSATOR
10.	THE SEDIMENT ____ AND ____ WAS ONCE A POPULAR FUEL FILTER.	BOWL SCREEN
11.	MOVEMENT OF THE ROCKER ARM IS CAUSED BY A CAMSHAFT ____.	ECCENTRIC
12.	FUEL PUMP LOCATION IS VARIABLE ON ____ ENGINES.	V-EIGHT
13.	PRESSURE IS CREATED IN THE PUMP CHAMBER BY A ____.	SPRING
14.	EXCESSIVE PUMP PRESSURE CAN CAUSE THE CARBURETOR TO ____.	FLOOD
15.	FUEL PUMP PRESSURE SHOULD BE FROM ____ TO ____ POUNDS.	3 5

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

THE PRIMARY FUNCTION OF A FUEL SYSTEM IS TO KEEP A READY SUPPLY OF FUEL AVAILABLE FOR THE ENGINE. SEVERAL METHODS HAVE BEEN TRIED IN ACCOMPLISHING THIS, BUT THE MOST SUCCESSFUL HAS PROVEN TO BE THE CARBURETOR RESERVOIR AND FUEL PUMP.

FUEL PUMPS ARE BROKEN DOWN INTO TWO BASIC TYPES: MECHANICAL AND ELECTRICAL. ELECTRICAL PUMPS ARE FOUND ON HEAVY DUTY VEHICLES SUCH AS TRUCKS AND BUSES. THE MECHANICAL PUMP IS THE MOST COMMON TYPE FOUND ON CARS.

MECHANICAL FUEL PUMP PARTS ARE: HOUSING, ROCKER ARM ASSEMBLY, DIAPHRAGM ASSEMBLY, PUMP CHAMBER, VALVE ASSEMBLY, AND FUEL COVER. MOST INCORPORATE A FUEL FILTER IN THEIR DESIGN.

LOCATION OF THE PUMP VARIES WITH ENGINE DESIGN, BUT IT IS MOST OFTEN MOUNTED ON THE SIDE OF THE BLOCK.

ATMOSPHERIC PRESSURE AND SPRING PRESSURE ARE USED TO MOVE FUEL FROM THE TANK THROUGH THE PUMP AND INTO A RESERVOIR IN THE CARBURETOR.

WEAR AND FATIGUE CAN CAUSE A FUEL PUMP TO MALFUNCTION. TESTS FOR FUEL PUMP EFFICIENCY INCLUDE: VOLUME OUTPUT, PRESSURE AT CRANKING SPEED, AND AMOUNT OF VACUUM THE PUMP WILL PRODUCE.

SUGGESTED READING FOR THE STUDENT:

AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 245-254

THE NEXT LESSON IS: VII-D-1(I), "CARBURETOR FUNDAMENTALS"

INSTRUCTOR'S PLAN VII-C-1(S)
MANIPULATIVE LESSON

TASK:	REMOVE AND REPLACE FUEL PUMP
AIM:	STUDENT WILL BE ABLE TO REMOVE AND REPLACE FUEL PUMP STUDENT WILL BE ABLE TO REPAIR DAMAGED FUEL LINES
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES, DROP LIGHT, FENDER COVER, CLEAN RAGS, NONFLAMMABLE SOLVENT, AND PARTS WASH PAN
MATERIALS:	
TEACHING AIDS:	TRANSPARENCIES I. ED. II 7 T FIGS, 556, 560
REFERENCES:	AUTOMECHANICS, GLENN, PP. 137-144 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 267-271 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-3 TO 20-13
PREREQUISITE EXPERIENCE OF LEARNER:	STUDENT MUST HAVE PASSED INFORMATION TEST SATISFACTORILY, READ THE RELATED MATERIALS AND BE INTERESTED TO CONTINUE WITH MANIPULATIVE SKILLS
CHECKING STANDARDS:	1. OBSERVATION OF SAFETY STANDARDS 2. OBSERVATION OF CARING FOR PAINTED SURFACE OF VEHICLE 3. PROPER TOOLS AND USE 4. STUDENT FOLLOWS DIRECTIONS

I. PREPARATION (OF THE LEARNER - MOTIVATION)

WHY REPLACE FUEL PUMP?

1. FAILURE TO SUPPLY GASOLINE TO CARBURETOR
2. LEAKS GASOLINE IN ENGINE COMPARTMENT
3. LEAKS GASOLINE INTO ENGINE CRANKCASE

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. PERFORM VEHICLE SAFETY	1. REFER TO: VII-B-1(TS) 2. INSTALL FENDER COVER
2. REMOVE FUEL LINES	1. DISCONNECT INLET LINE a. USE PLIERS b. RELEASE SPRING CLAMP

	c. MOVE CLAMP TOWARD REAR ON HOSE
	2. DISCONNECT OUTLET LINE a. USE PROPER LINE WRENCHES b. TURN NUT TO LEFT (COUNTER-CLOCKWISE) c. RETAIN FITTING WITH LINE WRENCH
3. DISCONNECT FUEL PUMP FROM ENGINE	3. REMOVE FUEL PUMP ATTACHING BOLTS a. USE PROPER SOCKET, SHORT EXTENSION, AND RATCHET b. TURN BOLTS TO LEFT (COUNTER-CLOCKWISE) c. PLACE BOLTS IN CONTAINER 4. REMOVE PUMP AND GASKET 5. DISCARD GASKET
4. INSTALL FUEL PUMP	1. REMOVE ALL GASKET MATERIAL FROM MOUNTING PAD AND PUMP 2. APPLY OIL-RESISTANT SEALER TO BOTH SIDES OF A NEW GASKET 3. POSITION GASKET ON FUEL PUMP FLANGE 4. HOLD FUEL PUMP IN POSITION AGAINST MOUNTING PAD CAUTION: MAKE SURE ROCKER ARM OR ROD IS RIDING ON THE CAMSHAFT OR INTERMEDIATE SHAFT ECCENTRIC 5. PRESS FUEL PUMP TIGHT AGAINST PAD 6. INSTALL ATTACHING BOLTS a. USE PROPER SOCKET AND TORQUE WRENCH b. TURN BOLTS TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS
5. CONNECT FUEL INLET HOSE	1. INSTALL CLAMP ON HOSE NOTE: USE NEW HOSE CLAMP 2. INSTALL HOSE ON FITTING 3. POSITION CLAMP ON HOSE TO SEAL HOSE TO FITTING
6. CONNECT OUTLET LINE	1. USE PROPER LINE WRENCHES 2. RETAIN FITTING WITH ONE WRENCH AND TURN NUT WITH ANOTHER 3. TIGHTEN TO SPECIFICATION NOTE: IF HOSE IS USED AT FUEL PUMP CONNECTION, CRIMP RETAINING CLAMP SECURELY

7. REPAIR FUEL LINE	1. CUT OUT DAMAGED SECTION OF FUEL LINE a. USE TUBING CUTTER b. REMOVE BURRS ON EDGES 2. FLARE ENDS OF CUT LINE a. USE TUBING FLARING TOOLS b. FORM A DOUBLE FLARE ON EACH END OF FUEL LINE 3. INSTALL PROPER SIZE RUBBER HOSE ON FUEL LINE NOTE: TWO INCH OVERLAP ON EACH END a. INSTALL CLAMP ON EACH END OF HOSE b. INSTALL HOSE ON LINE c. USE PROPER SCREWDRIVER d. TURN SCREWS TO RIGHT (CLOCK-WISE) e. TIGHTEN TO SPECIFICATIONS NOTE: NEVER INSTALL RUBBER HOSE WITHIN FOUR INCHES OF EXHAUST SY-STEM
8. MAKE VEHICLE READY	1. CONNECT POSITIVE BATTERY CABLE 2. CONNECT BATTERY GROUND CABLE a. USE BATTERY PLIERS b. TURN NUTS TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATION 3. REMOVE ALL TOOLS FROM VEHICLE 4. START ENGINE AND CHECK FOR FUEL AND OIL LEAKS NOTE: IF NO LEAKS APPEAR THE RE-PAIR IS SOUND
9. CLEAN WORK STATION	1. MOVE VEHICLE OUT OF WORK STATION 2. PARK VEHICLE IN PARKING AREA 3. CLEAN TOOLS AND RETURN TO STORAGE 4. PLACE TRASH IN COVERED TRASH CANS 5. SWEEP WORK STATION 6. PLACE RESIDUE IN TRASH CAN 7. RETURN CLEANING EQUIPMENT TO STORAGE

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. STUDENTS TO REPEAT STEPS OF THE TASK.

2. STUDENTS TO POINT OUT ITEMS OF SAFETY.

3. CAUTIONS AND PRECAUTIONS.

4. CHECK STUDENTS FOR KEY POINTS.

5. STUDENTS TO PRACTICE ON TASKS.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

1. PUT STUDENTS ON THEIR OWN TO PERFORM TASK (PERFORMANCE TEST).

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. REPEAT STEPS FROM STAGE II.

2. EMPHASIZE SAFETY AND CAUTIONS IN STAGE II.

3. EMPHASIZE CHECKING STANDARDS FOR THE TASK.

SUGGESTED READING FOR STUDENTS

AUTOMECHANICS, GLENN, PP. 137-144
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 267-271
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-3 TO 20-13

THE NEXT LESSON IS: VII-D-1(S), "REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR"

JOB SHEET VII-C-1(J)

ON

FUEL SYSTEM

JOB:	REMOVE AND REPLACE FUEL PUMP
MATERIALS:	CLEAN RAGS, GASKET SEALER, AND CLEANING SOLVENT
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES, DROP LIGHT, FENDER COVER, AND TUBE FLARING TOOLS
GENERAL INSTRUCTIONS:	BEFORE DOING THIS JOB THE STUDENT SHOULD PASS TEST ON INFORMATION LESSON: VII-C-1(I) AND SHOW DESIRE TO CONTINUE IN MANIPULATIVE SKILL PROCEDURE
PROCEDURES AND/OR TASKS:	VII-B-1(TS) PERFORM VEHICLE SAFETY VII-C-1(TS) REMOVE FUEL PUMP VII-C-1a(TS) INSTALL FUEL PUMP VII-B-1i(TS) MAKE VEHICLE READY VII-B-1j(TS) CLEAN WORK STATION VII-C-1b(TS) TEST FUEL PUMP VII-C-1c(TS) REPLACE FUEL FILTER
CHECK POINT:	1. OBSERVATION OF PROTECTING PAINT ON VEHICLE 2. OBSERVATION OF SAFETY RULES, SHOP POLICIES, AND REGULATIONS 3. USE TOOLS IN PROFESSIONAL AND CRAFTSMANLIKE MANNER 4. TAKE MENTAL NOTES OF ALL NEW TASKS AT HAND

TASK: REMOVE FUEL PUMP

JOB: REMOVE AND REPLACE FUEL PUMP

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, DROP LIGHT, FENDER COVER, AND SAFETY GOGGLES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. DISCONNECT FUEL LINES	1. RELEASE INLET LINE a. USE CLAMP PLIERS b. MOVE CLAMP TOWARD FUEL LINE c. SEPARATE HOSE FROM FITTING 2. UNSCREW OUTLET LINE NUT a. USE PROPER LINE WRENCHES b. RETAIN FITTING WITH ONE WRENCH c. TURN NUT TO LEFT (COUNTER-CLOCKWISE) WITH ANOTHER LINE WRENCH
2. DISCONNECT FUEL PUMP	1. REMOVE FUEL PUMP ATTACHING BOLTS a. USE PROPER SOCKET, SHORT EXTENSION AND RATCHET b. TURN BOLTS TO LEFT (COUNTER-CLOCKWISE) c. PLACE BOLTS IN CONTAINER 2. CAREFULLY REMOVE PUMP AND GASKET 3. DISCARD GASKET

TASK: INSTALL FUEL PUMP

JOB: REMOVE AND REPLACE FUEL PUMP

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, DROP LIGHT, AND FENDER COVER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE FUEL PUMP	1. REMOVE ALL GASKET MATERIAL FROM PUMP AND MOUNTING PAD a. SCRAPE OLD GASKET OFF PAD AND PUMP b. WIPE CLEAN WITH RAG 2. APPLY OIL RESISTANT SEALER TO BOTH SIDES OF NEW GASKET 3. POSITION GASKET ON FUEL PUMP FLANGE
2. POSITION FUEL PUMP	1. HOLD FUEL PUMP IN POSITION AGAINST MOUNTING PAD CAUTION: MAKE SURE ROCKER ARM OR ROD IS RIDING ON CAMSHAFT OR INTERMEDIATE SHAFT ECCENTRIC 2. PRESS FUEL PUMP TIGHT AGAINST PAD 3. INSTALL ATTACHING BOLTS a. USE PROPER SOCKET AND TORQUE WRENCH b. TURN BOLTS TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS
3. CONNECT INLET HOSE	1. INSTALL CLAMP ON HOSE NOTE: USE NEW HOSE CLAMP 2. INSTALL HOSE ON FITTING 3. POSITION CLAMP ON HOSE TO SEAL HOSE TO FITTING
4. CONNECT OUTLET LINE	1. USE PROPER SIZE LINE WRENCHES 2. RETAIN FITTING WITH ONE WRENCH AND TURN NUT WITH ANOTHER 3. TURN NUT TO RIGHT (CLOCKWISE) 4. TIGHTEN TO SPECIFICATIONS NOTE: IF HOSE IS USED AT FUEL PUMP CONNECTION, CRIMP RETAINING CLAMP SECURELY

STEPS	KEY POINTS
5. REPAIR FUEL LINE	1. CUT OUT DAMAGED SECTION OF FUEL LINE a. USE TUBING CUTTER b. REMOVE BURRS, FLARE ENDS OF CUT LINE (READ DIRECTIONS) c. USE TUBING FLARING TOOLS d. FORM A DOUBLE FLARE ON EACH END OF FUEL LINE 2. INSTALL PROPER SIZE RUBBER HOSE ON FUEL LINE NOTE: ALLOW TWO INCHES OVERLAP ON EACH END a. INSTALL CLAMP ON EACH END OF RUBBER HOSE b. INSTALL HOSE ON LINE c. POSITION CLAMPS BEHIND FLANGE d. TIGHTEN CLAMP SCREWS e. USE PROPER SIZE SCREWDRIVER f. TURN SCREWS TO RIGHT (CLOCK-WISE) g. TIGHTEN TO SPECIFICATIONS CAUTION: NEVER INSTALL RUBBER HOSE WITHIN FOUR INCHES OF EXHAUST SYSTEM

TASK: TEST FUEL PUMP

JOB: REMOVE AND REPLACE FUEL PUMP

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: TUBING WRENCHES, HOSE CLAMP PLIERS, FENDER COVER, SAFETY GOGGLES, DRIP PAN, VACUUM-PRESSURE GAGE WITH ADAPTERS, REMOTE STARTER SWITCH, SEAT COVER, AND CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS IN PREVIOUS TASKS
2. PREPARE VEHICLE	1. AS IN VII-A-1(TS)
3. PREPARE FOR TEST	1. DISCONNECT FUEL INLET LINE AS PER VII-C-1(TS) 2. PLUG FUEL HOSE TO PREVENT FUEL LEAKAGE 3. CONNECT VACUUM GAGE TO FUEL PUMP INLET TUBE
4. TEST VACUUM	1. START ENGINE AND LET IDLE 2. READ VACUUM GAGE NOTE: MINIMUM READING SHOULD BE 10 INCHES OF VACUUM AT IDLE 3. STOP ENGINE 4. REMOVE GAGE CONNECTIONS 5. UNPLUG FUEL LINE AND INSTALL ON FUEL PUMP INLET TUBE
5. TEST PRESSURE	1. DISCONNECT FUEL LINE AT CARBURETOR AS PER VII-C-1(TS) 2. CONNECT GAGE ADAPTER INTO FUEL LINE 3. START ENGINE AND LET IDLE 4. READ PRESSURE INDICATED ON GAGE NOTE: READING SHOULD BE AS SHOWN IN SPECIFICATIONS FOR PUMP BEING TESTED, AND REMAIN CONSTANT OR RETURN TO ZERO SLOWLY WHEN ENGINE IS STOPPED 5. STOP ENGINE 6. REMOVE GAGE CONNECTIONS 7. INSTALL FUEL LINE TO CARBURETOR

STEPS	KEY POINTS
	AND TIGHTEN
6. CLEAN WORK STATION	1. REMOVE TOOLS AND EQUIPMENT FROM VEHICLE 2. PARK VEHICLE 3. RETURN TOOLS AND EQUIPMENT TO STORAGE 4. CLEAN WORK AREA

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TASK: REPLACE FUEL FILTER (IN LINE)

JOB: REMOVE AND REPLACE FUEL PUMP

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: HOSE CLAMP PLIERS, HAND TOOLS, SAFETY GOGGLES, DRIP PAN, SEAT, FENDER COVER, AND CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS IN PREVIOUS TASKS
2. PREPARE VEHICLE	2. AS IN VII-A-1(TS)
3. REMOVE FILTER	1. POSITION DRIP PAN UNDER VEHICLE TO CATCH ANY SPILLED FUEL 2. REMOVE INLET AND OUTLET FUEL FILTER HOSE CLAMPS, WITH CORRECT TOOL 3. REMOVE IN LINE FUEL FILTER AND HOSES FROM FUEL LINES 4. DISPOSE OF OLD PARTS IN SAFE CONTAINER
4. INSTALL FILTER	1. ASSEMBLE NEW FUEL FILTER WITH HOSE AND CLAMPS 2. INSTALL FILTER ASSEMBLY ONTO FUEL LINES NOTE: USE CARE WHEN INSTALLING FILTER TO PREVENT ANY FOREIGN MATTER FROM ENTERING FUEL LINES 3. ADJUST AND TIGHTEN HOSE CLAMPS AND BRACKETS 4. START ENGINE AND RUN FOR A FEW MINUTES TO CHECK FOR FUEL LEAKS
5. CLEAN WORK STATION	1. AS PER VII-C-1b(TS)

INSTRUCTOR'S PLAN VII-D-1(I)
INFORMATIONAL LESSON

SUBJECT: CARBURETOR FUNDAMENTALS

AIM: THE STUDENT WILL BE ABLE TO DEFINE COMPONENTS AND CIRCUITS IN A CARBURETOR AND DESCRIBE THEIR OPERATION.

TEACHING AIDS: TRANSPARENCIES I. ED. II 7T, FIGS. 561-567
CARBURETOR
CHALKBOARD

MATERIALS: CHALK

REFERENCES: AUTOMOTIVE MECHANICS, CROUSE, CHS. 20 AND 26
AUTOMECHANICS, GLENN, CHS. 6 AND 11
AUTO SERVICE AND REPAIR, STOCKEL, CH. 20
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 245-254

PREREQUISITE EXPERIENCE OF THE LEARNER: THE STUDENT SHOULD HAVE READ THE ASSIGNMENT FOR THIS LESSON.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

ANYONE WHO HAS EVER FLOODED AN ENGINE SO THAT THE CAR WOULD NOT START KNOWS THAT IT CANNOT USE RAW LIQUID GASOLINE IN THE COMBUSTION CHAMBERS. GASOLINE MUST BE VAPORIZED AND MIXED WITH AIR IN ORDER TO BURN EFFECTIVELY. SEVERAL METHODS TO ACCOMPLISH THIS WERE TRIED WHEN ENGINES WERE FIRST BEING DEVELOPED. ONE INCLUDED DRAWING IN AIR OVER A PAN OF GASOLINE. THIS MIXTURE PROVED TO BE TOO LEAN, FOR GASOLINE WILL NOT EVAPORATE THAT QUICKLY UNLESS IT IS ATOMIZED. THE DEVICE THAT TURNS GASOLINE INTO VAPOR ALMOST INSTANTLY IS THE SUBJECT OF OUR LESSON TODAY: THE CARBURETOR.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PURPOSE	1. MIXES GASOLINE AND AIR DEPENDING ON ENGINE REQUIREMENTS 2. VARIES AMOUNTS OF EACH AUTOMATICALLY a. RICHER MIXTURE OF GASOLINE NEEDED FOR: (1) STARTING A COLD ENGINE

(2) FAST ACCELERATION
(3) IDLING

b. LEANER MIXTURE WITH LESS FUEL FOR PART-THROTTLE OPERATION

3. CONTROLS SPEED AND POWER BY REGULATING AMOUNT DELIVERED TO CYLINDERS

B. PRINCIPLES OF OPERATION

1. DESIGN IS COMPLICATED BUT OPERATION RELATIVELY SIMPLE
2. ALL USE PRESSURE DIFFERENCES TO FUNCTION
   a. DOWN STROKE OF PISTON CREATES VACUUM
   b. AIR RUSHES INTO CYLINDER FROM INTAKE MANIFOLD
   c. AIR TO MANIFOLD MUST COME THROUGH CARBURETOR
   d. FUEL VAPORIZED AND BLENDED BY PASSING AIR
   e. FUEL VAPORIZED AND BLENDED WITH AIR TO PRODUCE VOLATILE MIXTURE

SHOW: TRANSPARENCIES FIGS. 561

C. CONSTRUCTION

1. FLOAT SYSTEM

1. RESERVE BOWL LOCATED ON SIDE OF CARBURETOR
2. HOLDS GASOLINE SUPPLIED BY FUEL PUMP
3. FLOAT OPERATES NEEDLE VALVE TO CONTROL FUEL LEVEL
   a. FLOAT IN UP POSITION WHEN BOWL IS FULL
   b. NEEDLE SEATED IN VALVE STOPS INCOMING FUEL
   c. FLOAT DROPS AS BOWL EMPTIES
   d. NEEDLE UNSEATS ALLOWING MORE FUEL
4. LEVEL KEPT CONSTANT DURING ENGINE OPERATION
5. SOME HAVE DUAL FLOATS TO INSURE FUEL SUPPLY
6. BOWL VENTED TO INSIDE OF AIR HORN
7. MAY ALSO HAVE EXTERNAL VENT FOR IDLE

SHOW: TRANSPARENCY FIG. 562

8. FUEL CIRCUITS CONNECT TO CARBURETOR BODY

2. AIR HORN

1. ALLOWS ENTRY OF ALL AIR GOING TO CYLINDERS
2. OPERATES ON VENTURI PRINCIPLE
   a. AIR RUSHES THROUGH TUBE OR AIR HORN
   b. RESTRICTION OF FLOW PROVIDED BY VENTURI
   c. AIR SPEEDS UP AFTER PASSING VENTURI
   d. DIFFERENCE IN SPEED CREATES A VACUUM
   e. FUEL SUCKED IN FROM RESERVE BOWL
3. AIR HORN EQUIPPED WITH "BUTTERFLY" VALVES
   a. BELOW VENTURI IS THROTTLE OR VALVE
      (1) ROUND FLAT DISC MOUNTED ON A SHAFT
      (2) PIVOTS BY MEANS OF LINKAGE TO FOOT PEDAL
   b. CHOKE VALVE NEAR TOP ABOVE VENTURI
      (1) HAS SAME CONSTRUCTION AS THROTTLE VALVE
      (2) MAY BE CONTROLLED BY VACUUM, MANUAL, THERMOSTAT, OR ELECTRICITY
      (3) SOME HAVE TWO TYPES OF CONTROL

SHOW: TRANSPARENCY FIG. 561

3. IDLE CIRCUIT

1. IDLE TUBE CARRIES FUEL TO BASE OF AIR HORN
2. IDLE JET OPENS BELOW THROTTLE VALVE
3. AIR BLEED HOLES ALLOW AIR IN CIRCUIT
4. IDLE JET REGULATED BY ADJUSTABLE NEEDLE VALVE

SHOW: TRANSPARENCY FIG. 563

4. LOW SPEED

1. USES SAME FUEL TUBE AND PORT AS IDLE CIRCUIT

	2. ALSO USES SAME AIR BLEED HOLES
	3. LOW SPEED JET OPENS IMMEDIATELY ABOVE CLOSED POSITION OF THROTTLE VALVE
	4. OPENING THROTTLE SLIGHTLY ALLOWS BOTH JETS TO RELEASE FUEL AND AIR
5. HIGH SPEED OR MAIN METERING SYSTEM	1. USES THE MAIN METERING SYSTEM
	2. NOZZLE EMPTIES FUEL INTO MIDDLE AIR HORN
	3. AIR BLEED HOLE EMPTIES INTO MAIN DISCHARGE LINE
SHOW: TRANSPARENCY FIG. 564	4. MECHANICAL LINKAGE OR VACUUM OPERATES METERING ROD OR VALVE
	5. LIMITS FUEL FLOW IN HIGH SPEED JET AT PART THROTTLE OPERATION
	6. ANTISIPHON BLEED HOLE PREVENTS FUEL FLOW WHEN ENGINE STOPS
6. POWER FUEL SYSTEM	1. VACUUM PASSAGE CONNECTS MANIFOLD TO POWER VALVE CHAMBER IN MOST MODERN TYPES
	2. PISTON OR DIAPHRAGM LOCATED IN CHAMBER
SHOW: TRANSPARENCY FIG. 565	3. CALIBRATED SPRING UNDER PISTON
	4. PISTON CONNECTS TO POWER VALVE
	5. METERING ROD MAY REPLACE VALVE IN SOME
	6. FEW DESIGNS ARE MECHANICAL INSTEAD OF VACUUM
7. ACCELERATOR PUMP SYSTEM	1. OPERATED BY LINKAGE CONNECTED TO THROTTLE
	2. HAS SPRING LOADED PLUNGER OR DIAPHRAGM
	3. PUMP CYLINDER LINE EMPTIES INTO AIR HORN
	4. INLET AND DISCHARGE VALVES CONTROL FUEL MOVEMENT
D. CIRCUIT OPERATION	1. FUEL REQUIREMENTS VARY WITH CONDITIONS
	2. CIRCUITS AND SYSTEMS COMPENSATE FOR DIFFERENCES

1. IDLE CIRCUIT	1. THROTTLE VALVE CLOSED CUTTING OFF AIR THROUGH HORN 2. NO VACUUM DEVELOPED IN VENTURI 3. HIGH VACUUM BELOW THROTTLE DUE TO INTAKE MANIFOLD 4. FUEL - AIR MIXTURE FROM IDLE CIRCUIT DRAWN OUT OF JET BELOW THROTTLE 5. HIGH FUEL TO AIR RATIO (RICH MIXTURE) NEEDED AT IDLE
2. LOW SPEED CIRCUIT	1. OPENING THROTTLE PLATE SLIGHTLY MOVES ITS EDGE ABOVE LOW SPEED PORT 2. BOTH IDLE AND LOW SPEED PORTS FEED FUEL 3. AIR PASSING THROTTLE MIXED WITH FUEL 4. FUEL TO AIR RATIO LESS (LEANER) THAN AT IDLE
3. HIGH SPEED OR MAIN METERING SYSTEM	1. THROTTLE VALVE OPEN WIDE ALLOWING AIR PASSAGE 2. FUEL FED INTO VENTURI THROUGH MAIN METERING SYSTEM FROM CARBURETOR BOWL 3. IDLE AND LOW SPEED CIRCUITS CEASE TO FUNCTION 4. FUEL - AIR RATIO ABOUT SAME AS LOW SPEED CIRCUIT EXCEPT AT FULL THROTTLE 5. FULL THROTTLE OPERATION REQUIRES RICHER MIXTURE 6. EXTRA FUEL SUPPLIED BY POWER FUEL SYSTEM
4. POWER FUEL SYSTEM	1. MOST ARE VACUUM OPERATED BY INTAKE MANIFOLD 2. COMPOSED OF DIAPHRAGM OR PISTON LINKED TO METERING ROD OR VALVE AS PREVIOUSLY DESCRIBED 3. MANIFOLD VACUUM HOLDS PISTON OR DIAPHRAGM IN PLACE AT PART THROTTLE AND KEEPS VALVE CLOSED 4. VACUUM REDUCED WHEN THROTTLE OPENED WIDE

5. SPRING NOW PUSHES UP PISTON OR DIAPHRAGM
6. MOVEMENT UNSEATS METERING ROD OR VALVE
7. FUEL GOES THROUGH JET INTO MAIN DISCHARGE LINE

5. ACCELERATOR PUMP

1. QUICK OPENING OF THROTTLE ALLOWS EXCESS OF AIR
2. FUEL TO AIR RATIO GREATLY REDUCED
3. ACCELERATOR PUMP PREVENTS THIS
   a. PUMP PLUNGER FORCED DOWN BY THROTTLE LINKAGE
   b. PUMPS FUEL OUT JET INTO AIR HORN
   c. PROPER FUEL - AIR RATIO MAINTAINED
4. GIVES HIGH SPEED CIRCUIT TIME TO CATCH UP
5. SPRING MAINTAINS PUMP PRESSURE SEVERAL SECONDS
6. SECOND SPRING RETURNS PLUNGER TO NORMAL

6. CHOKE

1. FUEL VAPORIZED SLOWLY BY COLD ENGINE
2. EXCESS FUEL NEEDED FOR STARTING

SHOW: TRANSPARENCIES FIGS. 566-567

3. CHOKE VALVE CAUSES HIGH FUEL TO AIR RATIO
   a. VALVE CLOSES AT TOP OF AIR HORN
   b. INTAKE MANIFOLD PRODUCES HIGH VACUUM INSIDE
   c. FUEL IS SUCKED OUT NOZZLE OF MAIN DISCHARGE LINE
   d. VALVE OPENS AFTER ENGINE STARTS
4. PULL ROD CONNECTED TO DASH OPERATES CHOKE ON OLDER MODELS
5. MOST MODERN VEHICLES HAVE AUTOMATIC CHOKE
6. OPERATE ON TEMPERATURE AND VACUUM
7. BOTH UNITS CONNECT TO CHOKE VALVE

a. THERMOSTATIC WIRE COIL CLOSES VALVE WHEN COLD
b. HEAT CAUSES COIL TO UNWIND OPENING VALVE
c. INTAKE MANIFOLD PRODUCES VACUUM DURING CRANKING
d. VACUUM PISTON IS PULLED OUT OPENING VALVE SLIGHTLY
e. CHOKE VALVE CONTROLLED BY VACUUM PISTON DURING ENGINE WARM-UP
f. HEAT OF RUNNING ENGINE CAUSES THERMOSTATIC COIL TO TAKE OVER CHOKE VALVE OPERATION

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK QUESTIONS TO STIMULATE DISCUSSION AND CHECK COMPREHENSION OF THE MATERIAL PRESENTED.

EXAMPLE: WHY IS A RICH FUEL MIXTURE NEEDED TO START A COLD ENGINE?

ANSWER: GASOLINE VAPORIZES SLOWLY WHEN COLD, SO MORE IS REQUIRED TO GET THE PROPER FUEL-AIR RATIO.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

QUESTIONS: SIMPLE RECALL

1. THE TERM "RICH MIXTURE" MEANS A HIGHER ____ TO ____ RATIO. — FUEL / AIR
2. CARBURETORS USE ____ DIFFERENCES IN OPERATION. — PRESSURE
3. GASOLINE MUST BE ____ AND BLENDED WITH AIR IN ORDER TO BECOME A ____ MIXTURE. — VAPORIZED / VOLATILE
4. FUEL LEVEL IN THE RESERVE BOWL IS CONTROLLED BY A ____ AND ____ ____. — FLOAT / NEEDLE / VALVE
5. AN AIR HORN HAS A RESTRICTION CALLED A ____. — VENTURI

6. THE PURPOSE OF THE RESTRICTION IS TO INCREASE ____. — VACUUM

7. A DESCRIPTIVE NAME FOR THE VALVES IN THE AIR HORN IS ____. — BUTTERFLY

8. THE VALVE IN THE TOP OF THE AIR HORN IS THE ____ VALVE. — CHOKE

9. WHEN THE LOW SPEED CIRCUIT IS OPERATING, THE FUEL TO AIR RATIO IS ____ THAN AT IDLE. — LEANER

10. AUTOMATIC CHOKES WORK ON ____ AND ____. — TEMPERATURE, VACUUM

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

THE SOLE PURPOSE OF A CARBURETOR IS TO SUPPLY THE ENGINE WITH A CORRECT MIXTURE OF FUEL AND AIR DEPENDING ON CONDITIONS AND DEMANDS OF THE DRIVER.

SOMEWHAT COMPLICATED IN APPEARANCE, CARBURETORS USE DIFFERENCES IN PRESSURE FOR RELATIVELY SIMPLE OPERATION. AIR FLOW CONTROLLED BY VALVES CREATES VACUUM IN DIFFERENT AREAS OF THE AIR HORN. THIS IN TURN CALLS VARIOUS CIRCUITS INTO PLAY.

A RESERVE BOWL HOLDS GASOLINE TO BE USED BY THE CIRCUITS. CONSTANT FUEL LEVEL IS MAINTAINED BY A FLOAT AND NEEDLE VALVE SYSTEM.

ALL AIR ENTERING THE CYLINDERS MUST PASS THROUGH THE AIR HORN OF THE CARBURETOR. A RESTRICTION CALLED A VENTURI CREATES A VACUUM, AND CONTROL OF THE ENGINE SPEED IS ACCOMPLISHED BY LINKAGE WHICH ALLOWS THE DRIVER TO ADJUST THE AREA OF VACUUM IN THE AIR HORN.

THE THROTTLE VALVE IS CLOSED AT IDLE. THE INTAKE MANIFOLD CREATES A VACUUM BELOW IT, AND FUEL IS SUCKED OUT OF THE IDLE PORT. A LOW SPEED CIRCUIT PORT IS LOCATED IMMEDIATELY ABOVE THE CLOSED POSITION OF THE THROTTLE, AND OPENING IT SLIGHTLY CAUSES FUEL TO BE SUCKED OUT. BOTH IDLE AND LOW SPEED CIRCUITS FEED FUEL INTO THE CARBURETOR DURING LOW SPEED OPERATION.

THE HIGH SPEED CIRCUIT, POWER FUEL SYSTEM, AND ACCELERATOR PUMP MAINTAIN FUEL CONCENTRATION AT THE NECESSARY LEVELS EVEN THOUGH AIR HORN VACUUM CHANGES.

CHOKE VALVES WERE ONCE MANUALLY OPERATED, BUT MOST MODERN VEHICLES HAVE AN AUTOMATIC CHOKING DEVICE THAT OPERATES ON TEMPERATURE AND VACUUM TO INSURE THE CORRECT FUEL-AIR RATIO.

SUGGESTED READING FOR THE STUDENT:

AUTOMOTIVE MECHANICS, CROUSE, CHS. 20 AND 26.

THE NEXT LESSON IS: VII-D-2(I), "CARBURETOR TYPES AND SERVICE"

INSTRUCTOR'S PLAN VII-D-2(I)
INFORMATIONAL LESSON

SUBJECT:	CARBURETOR TYPES AND SERVICE
AIM:	THE STUDENT WILL BE ABLE TO COMPARE DIFFERENT TYPES OF CARBURETORS AND DESCRIBE SERVICE PROCEDURES.
TEACHING AIDS:	CARBURETORS CHALKBOARD
MATERIALS:	CHALK
REFERENCES:	AUTOMOTIVE MECHANICS, CROUSE, CHS. 9 AND 20 AUTOMECHANICS, GLENN, CHS. 6 AND 11 AUTO SERVICE AND REPAIR, STOCKEL, CH. 20 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 245-254
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE STUDENT SHOULD HAVE SATISFACTORILY COMPLETED THE LESSON ON CARBURETOR FUNDAMENTALS.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

IN THE LAST LESSON WE LEARNED HOW A RATHER COMPLICATED DEVICE, THE CARBURETOR, USES PRESSURE DIFFERENCES IN MIXING FUEL AND AIR TO MEET ENERGY REQUIREMENTS. THE IMPORTANCE OF THE CARBURETOR CANNOT BE STRESSED TOO MUCH, FOR WE KNOW THAT FUEL, COMPRESSION, AND IGNITION ARE WHAT MAKES AN ENGINE RUN. TODAY WE WILL SEE SOME DIFFERENT TYPES OF CARBURETORS AND LEARN SOME THINGS ABOUT SERVICE CONSIDERATIONS.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. TYPES OF CARBURETORS	1. THERE IS MUCH VARIATION IN CARBURETOR DESIGN 2. VARY WITH MANUFACTURERS, MODELS, AND ENGINES 3. SOME HAVE SPECIAL DEVICES a. SPARK ADVANCE VACUUM CIRCUITS b. TOP ENGINE SPEED CONTROLS OR GOVERNORS c. THROTTLE MODULATOR TO CLOSE VALVE COMPLETELY WHEN IGNI-

TION IS OFF

d. CARS WITH AUTOMATIC TRANSMISSION MAY HAVE:
   (1) ELECTRIC KICK DOWN SWITCH
   (2) THROTTLE RETURN CHECK OR DASHPOT TO SLOW DOWN THE CLOSING OF THROTTLE

B. CARBURETOR BARRELS

1. SINGLE BARREL MOST COMMON ON SMALL ENGINES
   a. CONSTRUCTION IS AS DESCRIBED IN PREVIOUS LESSON BUT WITH VARIATIONS
   b. IS LIMITED IN FUEL AND AIR OUTPUT
2. DUAL CARBURETOR COMPARABLE TO TWO SINGLES
   a. FUEL - AIR REQUIREMENTS FOR HALF THE CYLINDERS HANDLED BY EACH BARREL
   b. COMPLETE CIRCUITS IN EACH BARREL
   c. LINKAGE ALLOWS VALVES TOWORK TOGETHER
3. FOUR-BARREL COMPARABLE TO TWO DUALS IN A SINGLE UNIT
   a. PRIMARY SECTION CONTAINS TWO BARRELS
      (1) HAS IDLE, LOW-SPEED, HIGH SPEED, ACCELERATOR, AND POWER SYSTEMS
      (2) ALSO HAS AUTOMATIC CHOKE
   b. SECONDARY SECTICN ALSO HAS TWO BARRELS
      (1) CONTAINS HIGH SPEED CIRCUITS
      (2) ASSISTS PRIMARY BY CUTTING IN AT SPECIFIED SPEED OR ENGINE LOAD
      (3) SEPARATE THROTTLES OPEN BY DELAYED ACTION LINKAGE

C. COMBINATIONS

1. COMBINATIONS MAY BE USED ON HIGH PERFORMANCE ENGINES
2. REQUIRES SPECIALLY CONSTRUCTED INTAKE MANIFOLD

3. DUAL FOUR-BARREL CARBURETORS
   a. FRONT CARBURETOR ASSISTS ONE IN REAR
   b. FRONT ONE BEGINS TO OPEN WHEN REAR IS HALF OPEN
   c. BOTH OPEN AT FULL THROTTLE
   d. BASIC ADJUSTMENTS SAME AS FOR SINGLE
4. THREE DUAL CARBURETORS
   a. CENTRAL CARBURETOR CONTAINS ALL CIRCUITS
   b. FRONT AND REAR CONTAIN ONLY FLOAT, ACCELERATING, AND MAIN METERING CIRCUITS

D. LINKAGE

1. THROTTLE COMPLETELY OPEN WHEN FOOT PEDAL DEPRESSED
2. THROTTLE COMPLETELY CLOSED WHEN PEDAL RELEASED
3. SOME HAVE ADJUSTABLE LINKAGE TO ACCELERATOR PUMP
4. CLIPS, PINS, AND ADJUSTABLE JOINTS CONNECT LINKAGE COMPONENTS

E. GASKETS

1. NEW GASKETS ALWAYS USED IN ASSEMBLING CARBURETOR
2. GASKET BETWEEN CARBURETOR AND INTAKE MANIFOLD SHOULD BE IN PERFECT CONDITION OR REPLACED
3. MAY BE 1/2 INCH THICK TO PREVENT VAPOR LOCK

F. CAUSES OF MALFUNCTIONS

1. MOST CARBURETOR MALFUNCTIONS ARE DUE TO DIRT
   a. PLUGS AIR AND FUEL CIRCUITS
   b. CAUSES EXCESSIVE WEAR
2. OTHER MALFUNCTIONS DUE TO GUM AND RESIDUE CAUSING MOVING PARTS TO STICK
3. DEFECTIVE OR WORN PARTS
4. INCORRECT ADJUSTMENTS OF LINKAGE
5. INCORRECT SETTING OF AIR AND FUEL ADJUSTMENTS

G. ADJUSTMENTS

1. MANUFACTURER'S SHOP MANUAL GIVES SPECIFICATIONS ON INDIVIDUAL CARBURETORS

2. IDLE MIXTURE AND SPEED ADJUSTMENTS
   a. DETERMINE FUEL-AIR RATIO AND SPEED
   b. ARE MADE AT SAME TIME
   c. SPEED ADJUSTED TO GIVE RPM
   d. FUEL-AIR RATIO THEN ADJUSTED FOR SMOOTHNESS
3. LINKAGE ROD ALLOWS ACCELERATOR PUMP ADJUSTMENT
4. FLOAT, METERING ROD, AND OTHER PARTS ADJUSTABLE ON SOME

H. CLEANING SOLVENTS

1. GASOLINE OR DENATURED ALCOHOL ARE USED

   CAUTION: MOST CLEANING SOLVENTS ARE HIGHLY FLAMMABLE. HANDLE THEM WITH CARE

I. TESTERS

1. COMBUSTION ANALYZER CHECKS PERCENTAGE OF UNBURNED FUEL IN EXHAUST GAS
2. TACHOMETER GIVES ENGINE RPM FOR ADJUSTMENT OF CORRECT IDLE SPEED
3. VACUUM GAUGE USED TO ADJUST IDLE MIXTURE

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK QUESTIONS TO STIMULATE DISCUSSION AND CHECK COMPREHENSION OF INFORMATION PRESENTED IN THE LESSON.

EXAMPLE: WHAT IS THE ADVANTAGE OF HAVING MORE THAN ONE CARBURETOR ON AN ENGINE?

ANSWER: THEY INCREASE PERFORMANCE BY GIVING FASTER ACCELERATION AND HIGHER TOP SPEED.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

TRUE - FALSE TEST

1. GOVERNORS ARE DEVICES USED TO ADVANCE THE SPARK. F

2.	A THROTTLE MODULATOR CLOSES THE THROTTLE WHEN THE IGNITION IS TURNED OFF.	T
3.	CARS WITH STANDARD TRANSMISSIONS MAY HAVE A KICK DOWN SWITCH ON THE CARBURETOR.	F
4.	SMALLER ENGINES REQUIRE LESS CARBURETION.	T
5.	FOUR-BARREL CARBURETORS HAVE A PRIMARY AND A SECONDARY SECTION.	T
6.	DUAL CARBURETORS WHEN SINGLE MOUNTED CONTAIN COMPLETE CIRCUITS IN EACH BARREL.	T
7.	ON DUAL FOUR-BARREL COMBINATIONS, THE REAR CARBURETOR ASSISTS THE ONE IN FRONT.	F
8.	ON THREE DUAL CARBURETOR COMBINATIONS, THE CENTRAL ONE CONTAINS ALL THE CIRCUITS.	T
9.	THE CARBURETORS ALL CONTAIN FLOAT CIRCUITS IN THREE CARBURETOR COMBINATIONS.	T
10.	THE PRIMARY CAUSE OF CARBURETOR MALFUNCTION IS INCORRECT AIR AND FUEL ADJUSTMENTS.	F

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

AN ESTIMATED 500 DIFFERENT CARBURETORS HAVE BEEN MANUFACTURED IN THE UNITED STATES IN THE LAST 10 YEARS. THEY VARY WITH DESIGNER, ENGINE TYPE, DUTY PERFORMED, ETC., AND SOME ARE EQUIPPED WITH SPECIAL DEVICES.

THE SINGLE BARREL CARBURETOR IS PROBABLY THE MOST COMMON ON SMALL ENGINES, BUT MORE POWERFUL ENGINES MAY HAVE DUAL OR FOUR-BARREL CARBURETORS FOR BETTER FUEL AND AIR DISTRIBUTION.

CARBURETION REQUIREMENTS FOR HIGH PERFORMANCE ENGINES ARE MET BY SPECIAL MANIFOLDS WITH COMBINATIONS OF CARBURETORS. THEY ARE USUALLY A PAIR OF FOUR-BARRELS, THREE TWO-BARRELS, OR A SINGLE BARREL FOR EACH CYLINDER.

DIRT, WEAR, AND POOR ADJUSTMENTS CAUSE MOST CARBURETOR MALFUNCTIONS. THE MANUFACTURER'S SHOP MANUAL SHOULD ALWAYS BE CONSULTED, AND A VACUUM GAUGE, TACHOMETER, AND COMBUSTION ANALYZER SHOULD BE USED IN CARBURETOR REPAIR AND ADJUSTMENT.

SUGGESTED READING FOR THE STUDENT:

AUTO SERVICE AND REPAIR, STOCKEL, CH. 33

THE NEXT LESSON IS: VII-E-1(I), "HEAT RISER"

INSTRUCTOR'S PLAN VII-D-1(S)
MANIPULATIVE LESSON

TASK:	REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR
AIM:	STUDENT WILL BE ABLE TO PROPERLY REMOVE AND DISASSEMBLE A ONE BARREL CARBURETOR. THE STUDENT WILL LEARN THIS FIRST TASK AS A PART OF MAJOR TUNE-UP
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES, FLAT DRAIN PAN, FENDER COVERS, SEAT COVER, AND PARTS PAN
MATERIALS:	CLEAN RAGS
TEACHING AIDS:	TRANSPARENCIES: I. ED. II 7T, FIGS. 561-567
REFERENCES:	MANUFACTURER'S SERVICE MANUAL OF CARBURETOR AT HAND AUTOMECHANICS, GLENN, PP. 144-168 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29
PREREQUISITE EXPERIENCE OF THE LEARNER:	STUDENT MUST HAVE PASSED SATISFACTORILY THE TESTS ON THE INFORMATION LESSONS AND PROVE A DESIRE TO ADVANCE TO MANIPULATIVE SKILL LESSON.
CHECKING STANDARDS:	1. SELECT PROPER TOOLS AND EQUIPMENT 2. PROPER USE OF TOOLS AND EQUIPMENT 3. FOLLOW STEPS AND KEY POINTS 4. SAFETY PROCEDURES AND SHOP PRACTICES 5. EFFECTIVE EFFICIENT SERVICE OF REPAIRED VEHICLE 6. WORK IN A CRAFTSMANLIKE MANNER

I. PREPARATION (OF THE LEARNER - MOTIVATION)

A CARBURETOR IS THE PART THAT SUPPLIES AND METERS THE GASOLINE FOR THE ENGINE. THE CARBURETOR ALSO MIXES THE GASOLINE WITH THE AIR THAT ENTERS THE MANIFOLD. THE REASON FOR OVERHAULING A CARBURETOR IS TO KEEP THE FUEL-AIR RATIO AT PROPER SPECIFICATIONS. THIS WILL GIVE BEST PERFORMANCE AND ECONOMY. THIS LESSON WILL DEMONSTRATE THE CORRECT PROCEDURE IN THE REMOVAL AND DISASSEMBLY OF A ONE BARREL CARBURETOR. THE TEST WILL BE THE STUDENT'S ABILITY TO REMOVE AND DISASSEMBLE THE CARBURETOR CORRECTLY.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. PREPARE VEHICLE	1. AS IN PREVIOUS LESSONS
2. REMOVE AIR CLEANER	1. AS IN PREVIOUS LESSONS
3. REMOVE CARBURETOR	CAUTION: DO NOT ATTEMPT TO REMOVE CARBURETOR FROM ENGINE OF A VEHICLE THAT HAS JUST BEEN ROAD TESTED. ALLOW ENGINE TO COOL SUFFICIENTLY TO PREVENT ACCIDENTAL FUEL IGNITION OR PERSONAL INJURY 1. REMOVE THE GASOLINE TANK CAP TO RELIEVE POSSIBLE PRESSURE 2. PLACE A CONTAINER UNDER FUEL INLET FITTING TO CATCH ANY FUEL THAT MAY BE TRAPPED IN FUEL LINE 3. DISCONNECT FUEL LINE 4. USE TWO WRENCHES TO AVOID TWISTING LINE 5. DISCONNECT THROTTLE AND CHOKE LINKAGE 6. DISCONNECT ALL VACUUM LINES 7. REMOVE CARBURETOR BASE NUTS OR BOLTS NOTE: STORE NUTS OR BOLTS IN CONTAINER 8. CAREFULLY REMOVE CARBURETOR FROM ENGINE CAUTION: HOLD CARBURETOR LEVEL TO AVOID SPILLING FUEL FROM FUEL BOWL 9. PLACE CARBURETOR ON REPAIR STAND
4. DISASSEMBLE CARBURETOR	1. REMOVE BOWL VENT ASSEMBLY NOTE: PLACE ALL PARTS (EXCEPT DIAPHRAGMS) INTO CARBURETOR CLEANER TRAY 2. REMOVE FAST IDLE CAM RETAINING CLIP, IDLE CAM, AND LINK 3. DISCONNECT LINK 4. REMOVE CHOKE VACUUM DIAPHRAGM, LINK, AND BRACKET ASSEMBLY 5. DISENGAGE LINK FROM SLOT IN CHOKE LEVER NOTE: PLACE DIAPHRAGM TO ONE SIDE TO BE CLEANED AS SPECIAL ITEM

6. REMOVE POSITIVE THROTTLE RETURN SPRING AND PUMP ROCKER ARM AND LINKAGE ASSEMBLY
   CAUTION: BE SURE TO RELEASE SPRING TENSION BEFORE REMOVING RETAINING NUT AND LOCK WASHER
7. REMOVE BOWL COVER SCREWS AND LIFT BOWL COVER STRAIGHT UP UNTIL VACUUM PISTON STEM, ACCELERATOR PUMP, AND MAIN WELL TUBE ARE CLEAR OF MAIN BODY
   NOTE: SEPARATE BOWL COVER FROM CARBURETOR BODY BY TAPPING WITH A PLASTIC HAMMER OR HANDLE OF A SCREWDRIVER
   CAUTION: NEVER PRY COVER OFF WITH SCREWDRIVER BLADE
8. REMOVE BOWL COVER GASKET
   NOTE: IF ANY GASKET MATERIAL IS REMAINING ON EITHER SURFACE, REMOVE WITH A SUITABLE CLEANER
   CAUTION: DO NOT USE A METAL SCRAPER SUCH AS A CARBON SCRAPER OR SCREWDRIVER ON EITHER BOWL OR COVER SURFACE. A NYLON OR HARD PLASTIC MATERIAL MAY BE USED AS A SUITABLE SCRAPER

5. DISASSEMBLE CARBURETOR COVER

1. REMOVE ACCELERATING PUMP OPERATING ROD RETAINER SCREW AND RETAINER
2. ROTATE PUMP OPERATING ROD
3. DISCONNECT PUMP DRIVE SPRING
4. REMOVE ACCELERATING PUMP ASSEMBLY
   NOTE: SET PUMP STEM AND CUP ASIDE DO NOT IMMERSE IN CLEANER
5. ROTATE PUMP OPERATING ROD
6. REMOVE PUMP OPERATING ROD FROM BOWL COVER
7. REMOVE PUMP OPERATING ROD GROMMET
   NOTE: THE POWER PISTON ASSEMBLY RETAINING RING IS STAKED IN POSITION, CARE MUST BE TAKEN IN REMOVAL

8. REMOVE STAKING WITH SUITABLE SHARP TOOL
9. REMOVE VACUUM PISTON FROM BOWL COVER
10. DEPRESS PISTON AND ALLOW IT TO SNAP UP AGAINST RETAINING RING

NOTE: THIS COMPLETES DISASSEMBLY OF BOWL COVER. MAIN WELL TUBE CANNOT BE REMOVED AND MUST BE CAREFULLY BLOWN OUT FROM BOTH INSIDE AND OUTSIDE OF COVER

6. DISASSEMBLE CARBURETOR MAIN BODY

1. REMOVE FUEL INLET FITTING VALVE ASSEMBLY FROM MAIN BODY
2. SEPARATE THE GASKETS FROM THE PARTS
3. REMOVE THE SPRING FLOAT SHAFT RETAINER, FLOAT SHAFT, AND FLOAT ASSEMBLY
4. TURN CARBURETOR BODY UPSIDE DOWN AND REMOVE PUMP DISCHARGE CHECK BALL AND WEIGHT
5. REMOVE THE MAIN JET
   a. USE THE PROPER SIZE SCREWDRIVER
   b. TURN JET TO LEFT (COUNTER-CLOCKWISE)

   NOTE: BE SURE SCREWDRIVER HAS GOOD SQUARE BLADE

   CAUTION: CAREFULLY DEPRESS POWER VALVE NEEDLE WITH PROPER SCREWDRIVER UNTIL SCREWDRIVER BLADE IS SQUARELY SEATED IN SLOT ON TOP OF VALVE
6. REMOVE VALVE

   NOTE: THE POWER VALVE ASSEMBLY CONSISTS OF THE SEAT, NEEDLE, AND SPRING. ALL OF THESE COMPONENTS OF THE SERVICE POWER VALVE SHOULD BE USED IF REPLACEMENT IS REQUIRED
7. REMOVE THROTTLE BODY SCREWS FROM MAIN BODY
8. SEPARATE MAIN BODY FROM THROTTLE BODY
9. DISCARD OLD GASKET
10. REMOVE CURB IDLE SCREW

	11. TURN THE LIMITER CAP TO ITS LEANEST POSITION AND REMOVE CAP NOTE: GENTLY TURN THE IDLE MIXTURE SCREW CLOCKWISE UNTIL IT SEATS NOTE: RECORD STARTING POSITION AND EXACT NUMBER OF TURNS REQUIRED TO SEAT SCREW. THIS IS NECESSARY TO RE-INSTALL IT IN SAME POSITION AFTER REMOVAL AND CLEANING
7. CLEAN WORK STATION	1. PLACE ALL PARTS IN PROPER ORDER IN PREPARATION FOR CLEANING 2. CLEAN TOOLS 3. RETURN TOOLS TO STORAGE AREA 4. CLEAN BENCH AND WORK AREA 5. RETURN FENDER COVERS AND SEAT COVERS TO PROPER STORAGE AREA 6. PREPARE FOR NEXT LESSON

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. FURNISH STUDENTS WITH JOB AND TASK SHEETS.
2. STUDENT TO PRACTICE ON TASKS.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

1. CORRECT REMOVAL OF CARBURETOR.
2. CORRECT DISASSEMBLY OF CARBURETOR.
3. ARRANGEMENT OF PARTS IN PREPARATION FOR CLEANING PARTS.
4. OBSERVANCE OF GOOD WORK SAFETY HABITS.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. EMPHASIZE SAFETY WORK HABITS.
2. POINT OUT STEP BY STEP PROCEDURE FOR CARBURETOR REMOVAL AND DISASSEMBLY.
3. REVIEW TASK OF REMOVAL AND DISASSEMBLY OF CARBURETOR.

SUGGESTED READING FOR STUDENTS:

AUTOMECHANICS, GLENN, PP. 144-168
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29

THE NEXT LESSON IS: VII-D-2(S) "CLEAN, INSPECT, REPAIR, OR REPLACE PARTS OF ONE BARREL CARBURETOR"

JOB SHEET VII-D-1(J)
ON
FUEL SYSTEM

JOB:	REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR	
MATERIALS:	CLEAN RAGS	
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, FENDER COVERS, SEAT COVERS, DROP LIGHT, AND SPECIAL CARBURETOR TOOLS	
GENERAL INSTRUCTIONS:	SAFETY GOGGLES OR GLASSES MUST BE WORN AT ALL TIMES TO PROTECT THE EYES FROM GASOLINE AND DIRT	
PROCEDURE AND/OR TASKS:	VII-A-1(TS)	PREPARE VEHICLE
	VII-A-1c(TS)	REMOVE AIR CLEANER
	VII-D-1(TS)	REMOVE ONE BARREL CARBURETOR FROM VEHICLE
	VII-D-1a(TS)	DISASSEMBLE THROTTLE BODY FLANGE ASSEMBLY
	VII-D-1b(TS)	DISASSEMBLE ONE BARREL CARBURETOR BOWL COVER
	VII-D-1c(TS)	DISASSEMBLE ONE BARREL CARBURETOR MAIN BODY

CHECK POINTS:

1. HAVE INSTRUCTOR CHECK FOR PROPER DISASSEMBLY
2. CHECK CARBURETOR FOR TYPE METAL PRIOR TO SELECTION OF CARBURETOR CLEANER
   CAUTION: CERTAIN CLEANERS CAUSE A CHEMICAL REACTION TO THE METAL
3. CHECK WITH INSTRUCTOR BEFORE PROCEEDING TO CLEANING AND INSPECTION

TASK: REMOVE ONE BARREL CARBURETOR FROM VEHICLE

JOB: REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, FENDER COVERS, SEAT COVER, DROP LIGHT, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE VEHICLE	CAUTION: DO NOT ATTEMPT TO REMOVE CARBURETOR FROM ENGINE OF VEHICLE THAT HAS JUST BEEN ROAD TESTED. ALLOW ENGINE TO COOL SUFFICIENTLY TO PREVENT ACCIDENTAL FUEL IGNITION OR PERSONAL INJURY 1. REMOVE GASOLINE TANK CAP TO RELIEVE POSSIBLE PRESSURE 2. OPEN HOOD 3. INSTALL FENDER COVERS
2. REMOVE AIR CLEANER	1. REFER TO VII-A-1(TS)
3. DISCONNECT CARBURETOR	1. PLACE CONTAINER UNDER INLET FUEL FITTING 2. LOOSEN INLET FUEL LINE NUT WITH TWO WRENCHES CAUTION: USE TWO TUBING NUT WRENCHES TO AVOID DAMAGE TO NUTS OR TWISTING FUEL LINE 3. DISPOSE OF GASOLINE FROM LINE 4. DISCONNECT THROTTLE AND CHOKE LINKAGE a. USE THIN NOSE PLIERS b. PULL OFF RETAINERS c. PLACE RETAINERS IN CONTAINER 5. REMOVE CARBURETOR BASE NUTS OR BOLTS a. USE PROPER WRENCH b. TURN NUTS OR BOLTS TO LEFT (COUNTERCLOCKWISE) c. PLACE NUTS OR BOLTS IN CONTAINER

STEPS	KEY POINTS
	6. CAREFULLY LIFT CARBURETOR FROM ENGINE CAUTION: HOLD CARBURETOR LEVEL TO AVOID SPILLING FUEL FROM FUEL BOWL 7. PLACE CARBURETOR ON REPAIR STAND

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TASK: DISASSEMBLE THROTTLE BODY FLANGE ASSEMBLY

JOB: REMOVE AND DISSASSEMBLE ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND, TRAY FOR PARTS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE EXTERNAL PARTS	NOTE: PLACE ALL PARTS (EXCEPT DIAPHRAGMS) IN CARBURETOR PARTS CLEANER TRAY 1. REMOVE BOWL VENT ASSEMBLY a. USE PROPER SCREWDRIVER b. TURN SCREW TO LEFT (COUNTER-CLOCKWISE) c. PLACE SCREW AND ASSEMBLY IN CONTAINER 2. REMOVE FAST IDLE CAM RETAINING CLIP, IDLE CAM, AND LINK a. PRY CLIP OFF WITH PROPER SIZE SCREWDRIVER b. LIFT OFF CAM AND LINKS c. PLACE IN CONTAINER 3. REMOVE CHOKE DIAPHRAGM, LINK, AND BRACKET ASSEMBLY a. USE PROPER SIZE SCREWDRIVER b. TURN SCREWS TO LEFT (COUNTER-CLOCKWISE) c. DISCONNECT LINK NOTE: PLACE DIAPHRAGM TO ONE SIDE (TO BE CLEANED AS SPECIAL ITEM) 4. REMOVE POSITIVE THROTTLE ASSEMBLY a. USE PROPER SOCKET AND RATCHET b. TURN NUT TO LEFT (COUNTER-CLOCKWISE) c. PLACE NUT AND WASHER IN CONTAINER

TASK: DISASSEMBLE ONE BARREL CARBURETOR BOWL COVER

JOB: REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE ACCLERATOR PUMP	1. REMOVE ACCELERATOR PUMP OPERATING ROD RETAINER SCREW a. USE PROPER SCREWDRIVER b. TURN SCREW TO LEFT (COUNTER-CLOCKWISE) c. PLACE SCREW IN CONTAINER 2. LIFT OUT RETAINER 3. ROTATE PUMP OPERATING ROD 4. DISCONNECT PUMP DRIVE SPRING a. USE FINGERS TO REMOVE LOCK b. PLACE LOCKS IN CONTAINER 5. REMOVE ACCELERATING PUMP ASSEMBLY NOTE: PLACE PUMP STEM AND CUP WITH CHOKE 6. ROTATE PUMP OPERATING ROD 7. REMOVE FROM BOWL COVER 8. REMOVE PUMP OPERATING ROD GROMMET NOTE: THE POWER PISTON ASSEMBLY RETAINING RING IS STAKED IN POSITION, CARE MUST BE TAKEN AT REMOVAL 9. REMOVE STAKING WITH SUITABLE SHARP TOOL 10. REMOVE VACUUM PISTON FROM BOWL COVER 11. DEPRESS PISTON AND ALLOW IT TO SNAP UP AGAINST RETAINING RING 12. LIFT OUT OF COVER

TASK: DISASSEMBLE ONE BARREL CARBURETOR MAIN BODY

JOB: REMOVE AND DISASSEMBLE ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE FUEL INLET VALVE ASSEMBLY	1. USE PROPER WRENCH a. TURN FITTING TO LEFT (COUNTER-CLOCKWISE) b. DISCARD VALVE ASSEMBLY 2. REMOVE FUEL INLET VALVE GASKET AND DISCARD
2. REMOVE FLOAT ASSEMBLY	1. REMOVE SPRING FLOAT SHAFT RETAINER a. USE MEDIUM SCREWDRIVER b. PRY RETAINER OUT AND UP c. HOLD RETAINER TO PREVENT IT FROM FLYING AWAY 2. LIFT OUT FLOAT SHAFT AND FLOAT ASSEMBLY
3. REMOVE PUMP CHECK BALL AND WEIGHT	1. TURN CARBURETOR BODY UPSIDE DOWN 2. DUMP CHECK BALL AND WEIGHT INTO HAND 3. PLACE IN CONTAINER
4. REMOVE MAIN JET	1. USE PROPER SCREWDRIVER a. TURN JET TO LEFT (COUNTER-CLOCKWISE) b. PLACE JET IN CONTAINER NOTE: BE SURE SCREWDRIVER HAS GOOD SQUARE BLADE
5. REMOVE POWER VALVE	CAUTION: CAREFULLY DEPRESS POWER VALVE NEEDLE WITH PROPER SCREWDRIVER UNTIL SCREWDRIVER BLADE IS SQUARELY SEATED IN SLOT ON TOP OF VALVE 1. UNSCREW POWER VALVE a. USE PROPER SCREWDRIVER

STEPS	KEY POINTS
	b. TURN VALVE TO LEFT (COUNTER-CLOCKWISE) c. PLACE VALVE ASSEMBLY IN CONTAINER NOTE: THE POWER VALVE ASSEMBLY CONSISTS OF SEAT, NEEDLE, AND SPRING. ALL OF THESE COMPONENTS OF SERVICE POWER VALVE SHOULD BE USED IF REPLACEMENT IS REQUIRED
6. SEPARATE MAIN BODY FROM THROTTLE BODY	1. REMOVE MAIN BODY TO THROTTLE BODY SCREWS a. USE PROPER SCREWDRIVER b. TURN SCREWS TO LEFT (COUNTER-CLOCKWISE) 2. SEPARATE MAIN BODY FROM THROTTLE BODY a. STRIKE THROTTLE BODY WITH PLASTIC HAMMER b. DISCARD OLD GASKET 3. REMOVE CURB IDLE AIR - FUEL RATIO ADJUSTING SCREW a. TURN LIMITER CAP TO LEANEST POSITION b. LIFT OFF AND DISCARD NOTE: GENTLY TURN IDLE MIXTURE SCREW CLOCKWISE UNTIL IT SEATS. RECORD STARTING POSITION AND EXACT NUMBER OF TURNS REQUIRED TO SEAT SCREW. THIS IS NECESSARY TO REINSTALL IT IN SAME POSITION AFTER REMOVAL AND CLEANING

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INSTRUCTOR'S PLAN VII-D-2(S)
MANIPULATIVE LESSON

TASK:	CLEAN, INSPECT, REPAIR, OR REPLACE ONE BARREL CARBURETOR PARTS
AIM:	STUDENT WILL BE ABLE TO CORRECTLY AND SAFELY CLEAN, INSPECT, REPAIR, OR REPLACE THE PARTS OF A ONE BARREL CARBURETOR AS ONE TASK IN MAJOR TUNE UP
TOOLS AND EQUIPMENT:	SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS, BASIC HAND TOOLS, CLEANING VAT, AND AIR HOSE
MATERIALS:	CLEAN RAGS, SOLVENT OR KEROSENE, AND CARBURETOR CLEANER
TEACHING AIDS:	I. ED. II 7T, FIGS. 561-567
REFERENCES:	MANUFACTURER'S SERVICE MANUAL OF CARBURETOR AT HAND AUTOMECHANICS, GLENN, PP. 144-168 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29
PREREQUISITE EXPERIENCE OF THE LEARNER:	STUDENT MUST HAVE COMPLETED SATISFACTORILY THE TEST ON INFORMATION LESSONS, COMPLETED SATISFACTORILY THE ASSIGNED TASK IN VII-D-1, AND PROVE A DESIRE TO ADVANCE TO MANIPULATIVE SKILL LESSON
CHECKING STANDARDS:	1. SELECT PROPER TOOLS AND EQUIPMENT 2. PROPER USE OF TOOLS AND EQUIPMENT 3. FOLLOW STEPS AND KEY POINTS 4. SAFETY PROCEDURES AND SHOP PRACTICES 5. DISPLAY A CRAFTSMANLIKE ATTITUDE

I. PREPARATION (OF THE LEARNER - MOTIVATION)

MUCH OF CARBURETOR PROBLEMS ARE THE RESULTS OF DAMAGED OR WORN, DIRTY OR GUMMED, INORPERATIVE PARTS. IN ORDER FOR CARBURETOR OVERHAUL TO BE SUCCESSFUL, THE PARTS MUST BE PROPERLY CLEANED, CAREFULLY INSPECTED, AND ANY DAMAGED PARTS EITHER REPAIRED OR REPLACED. TO PROPERLY CLEAN THE CARBURETOR REQUIRES A KNOWLEDGE OF THE MATERIAL THE CARBURETOR IS MADE OF. CERTAIN CLEANERS CAUSE A CHEMICAL REACTION WITH THE MATERIAL, THEREBY CAUSING DETERIORATION. THIS LESSON WILL DEMONSTRATE THE CORRECT PROCEDURE FOR CLEANING, INSPECTING, AND THE REPAIR OR REPLACEMENT OF DAMAGED PARTS.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. SOAK PARTS	1. SELECT CLEANER NOTE: SOME CLEANERS CAUSE A CHEMICAL REACTION WITH THE CARBURETOR BODY. USE CLEANER RECOMMENDED CAUTION: USE EYE SAFETY PROTECTION WHEN WORKING WITH CARBURETOR CLEANER 2. PLACE PARTS IN PARTS TRAY CAUTION: DO NOT PLACE PARTS MADE OF FABRIC OR RUBBER IN CLEANER 3. SUBMERGE PARTS IN CLEANER 4. SOAK FOR RECOMMENDED TIME NOTE: APPROXIMATELY 30 MINUTES NOTE: KEEP PARTS CLEANER COVER ON
2. REMOVE PARTS	1. REMOVE TRAY FROM CLEANER 2. PERMIT PARTS TO DRAIN INTO TANK CAUTION: AVOID GETTING CLEANER ON SKIN. WASH IMMEDIATELY WITH WATER SHOULD THIS HAPPEN
3. WASH AND BLOW DRY PARTS	1. RINSE PARTS THOROUGHLY WITH WATER 2. BLOW DRY PARTS WITH COMPRESSED AIR NOTE: FORCE AIR THROUGH ALL JETS AND PASSAGES CAUTION: POSITION PARTS SO AS TO PREVENT BLOW BACK OF WATER AND AIR INTO FACE OR EYES NOTE: DO NOT WIRE BRUSH PARTS OR RUN WIRE THROUGH JETS
4. ARRANGE PARTS IN THEIR RESPECTIVE ASSEMBLIES	1. ARRANGE PARTS IN RESPECTIVE ORDER 2. CLEAN PARTS THAT WERE NOT SOAKED IN CLEANER NOTE: WIPE PARTS WITH EITHER CLEAN RAG OR CLEAN RAG DAMPENED WITH KEROSENE OR SOLVENT
5. INSPECT BODY OF CARBURETOR a. AIR HORN BODY b. MAIN BODY c. THROTTLE BODY	1. INSPECT BODY FOR CRACKS 2. CHECK GASKET SURFACE FOR WARPAGE 3. CHECK FOR NICKS AND OTHER DEFECTS

6.	INSPECT CHOKE AND THROTTLE SHAFTS	1. INSPECT SHAFTS FOR GROOVES, WEAR, LOOSENESS, OR BINDING 2. INSPECT THROTTLE SHAFT AND BEARING FOR EXCESSIVE WEAR 3. INSPECT FOR OUT-OF-ROUND NOTE: REPLACE CARBURETOR ASSEMBLY SHOULD WEAR BE EXCESSIVE
7.	INSPECT FASTENERS	1. INSPECT FOR DAMAGE OR STRIPPED THREADS 2. CHECK FOR DISTORTED SPRINGS 3. INSPECT BOLT AND SCREW HEADS FOR DAMAGE
8.	CHECK IDLE MIXTURE AND SPEED ADJUSTING SCREWS	1. CHECK SCREW POINT FOR DAMAGE 2. INSPECT TAPERED PORTION FOR RIDGED OR GROOVED SURFACE 3. CHECK FOR OUT-OF-ROUND
9.	INSPECT CHOKE PLATE AND CHOKE PISTON	1. CHECK CHOKE PLATE FOR NICKS 2. CHECK CHOKE PISTON FOR EASE OF OPERATION
10.	CHECK FLOAT	1. TEST FLOAT FOR LEAKAGE NOTE: HOLD FLOAT IN WATER HEATED TO APPROXIMATELY 200° F NOTE: BUBBLES WILL APPEAR IF FLOAT LEAKS 2. INSPECT FLOAT ARM FOR ROUGHNESS OR GROOVINGS
11.	PREPARE TO REASSEMBLE CARBURETOR	1. REPAIR PARTS REPAIRABLE 2. REPLACE PARTS UNREPAIRABLE
12.	CLEAN WORK STATION	1. SECURE PARTS CLEANER 2. DISPOSE OF OILY RAGS 3. RESTORE AIR HOSE TO PROPER PLACE 4. PROPERLY CLEAN FLOOR AREA

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. FURNISH STUDENTS WITH JOB AND TASK SHEETS.
2. STUDENT TO PRACTICE ON TASKS.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

1. SELECTION OF PARTS CLEANER

2. PROPER CLEANING OF ALL CARBURETOR PARTS.
3. INSPECTION OF AND REPAIR OR REPLACEMENT OF DAMAGED PARTS.
4. OBSERVANCE OF GOOD WORK SAFETY HABITS.
5. PROPER SECURING OF WORK STATION.
6. PRELIMINARY PREPARATION FOR REASSEMBLY OF CARBURETOR.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. EMPHASIZE SAFETY.
2. POINT OUT STEP BY STEP PROCEDURE FOR CLEANING AND INSPECTION.
3. POINT OUT DETERMINING FACTORS IN REPAIR OR REPLACEMENT OF PARTS.
4. REVIEW TASK OF CLEANING, INSPECTING, AND REPAIR OR REPLACEMENT OF PARTS.

SUGGESTED READING FOR STUDENTS:

MANUFACTURER'S SERVICE MANUAL OF CARBURETOR AT HAND
AUTOMECHANICS, GLENN, PP. 144-168
AUTOMOTIVE ENCYCLOPEDIA, TOBOLT, PP. 217-266
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29

THE NEXT LESSON IS: VII-D-3(S) "REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENTS"

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JOB:	CLEAN AND INSPECT ONE BARREL CARBURETOR
MATERIALS:	CLEAN RAGS AND CARBURETOR CLEANER
TOOLS AND EQUIPMENT:	SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS, AND CARBURETOR CLEANER CAUTION: DO NOT PERMIT CARBURETOR CLEANER TO COME INTO CONTACT WITH SKIN, EYES OR CLOTHING
PROCEDURE AND/OR TASKS:	VII-D-2(TS) CLEAN CARBURETOR PARTS VII-D-2a(TS) INSPECT, AND REPAIR OR REPLACE PARTS ON A ONE BARREL CARBURETOR

CHECK POINT:

1. HAVE INSTRUCTOR CHECK ALL PARTS FOR PROPER CLEANING.
2. CHECK WITH INSTRUCTOR ON PARTS REQUIRING REPAIR OR REPLACEMENT.
3. CHECK WITH INSTRUCTOR BEFORE PROCEEDING TO TASK OF REASSEMBLING CARBURETOR.
4. CORRECT SELECTION OF TOOLS.
5. ADHERENCE TO SAFETY PROCEDURES AND PRACTICE.

TASK: CLEAN ONE BARREL CARBURETOR PARTS

JOB: CLEAN AND INSPECT ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEAN RAGS, SAFETY GOGGLES, WATER, CARBURETOR CLEANER, COMPRESSED AIR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SOAK PARTS	1. SELECT CLEANER NOTE: SOME CLEANERS CAUSE A CHEMICAL REACTION WITH THE CARBURETOR BODY; USE CLEANER RECOMMENDED CAUTION: USE EYE SAFETY PROTECTION WHEN WORKING WITH CLEANER 2. PLACE PARTS IN PARTS TRAY CAUTION: DO NOT PLACE PARTS MADE OF FABRIC OR RUBBER IN CLEANER 3. SUBMERGE PARTS IN CLEANER 4. SOAK PARTS FOR RECOMMENDED TIME NOTE: APPROXIMATELY 30 MINUTES NOTE: KEEP PARTS CLEANER COVER ON DURING SOAKING PERIOD
2. REMOVE PARTS	1. LIFT TRAY FROM CLEANER 2. PERMIT PARTS TO DRAIN INTO TANK CAUTION: AVOID GETTING CLEANER ON SKIN. WASH IMMEDIATELY WITH WATER SHOULD THIS HAPPEN
3. WASH AND BLOW DRY PARTS	1. RINSE PARTS THOROUGHLY WITH WATER 2. BLOW DRY PARTS WITH COMPRESSED AIR NOTE: FORCE AIR THROUGH ALL PASSAGES CAUTION: POSITION PARTS SO AS TO PREVENT RETURN OF AIR AND WATER FROM BLOWING BACK INTO FACE OR EYES NOTE: DO NOT WIRE BRUSH PARTS OR RUN WIRE THROUGH JETS 3. ARRANGE PARTS IN THEIR RESPECTIVE ASSEMBLIES

STEPS	KEY POINTS
	NOTE: PARTS THAT ARE NOT SOAKED IN CLEANER MAY BE WIPED CLEAN WITH A CLEAN RAG OR A CLEAN RAG DAMPENED WITH KEROSENE OR A SOLVENT

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TASK: INSPECT AND REPAIR OR REPLACE PARTS ON A ONE BARREL CARBURETOR

JOB: CLEAN AND INSPECT ONE BARREL CARBURETOR

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS, AND CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSPECT BODY OF CARBURETOR a. AIR HORN BODY b. MAIN HOUSING c. THROTTLE BODY	1. INSPECT FOR CRACKS IN THE BODY 2. CHECK GASKET SURFACES FOR WARPAGE WITH STRAIGHT EDGE 3. CHECK FOR NICKS AND OTHER DEFECTS
2. INSPECT CHOKE AND THROTTLE SHAFTS	1. CHECK SHAFTS FOR GROOVE, WEAR, LOOSENESS, OR BINDING 2. INSPECT THROTTLE SHAFT AND ITS BEARING FOR EXCESSIVE WEAR 3. INSPECT FOR OUT-OF-ROUNDNESS NOTE: REPLACE CARBURETOR ASSEMBLY SHOULD WEAR BE EXCESSIVE
3. INSPECT FASTENERS	1. CHECK FOR STRIPPED OR DAMAGED THREADS 2. CHECK FOR DISTORTED SPRINGS 3. INSPECT BOLTS AND SCREWS FOR DAMAGED HEADS
4. CHECK IDLE MIXTURE SCREWS	1. INSPECT FOR GROOVED OR RIDGED TAPER PORTION 2. INSPECT FOR OUT-OF-ROUND 3. CHECK SCREW POINT FOR DAMAGE
5. INSPECT CHOKE PLATE AND CHOKE PISTON	1. CHECK PLATE FOR NICKS 2. CHECK CHOKE PISTON FOR EASE OF OPERATION
6. CHECK FLOAT	1. TEST FLOAT FOR LEAKAGE NOTE: HOLD FLOAT IN WATER HEATED TO APPROXIMATELY 200° F NOTE: BUBBLES WILL APPEAR IF FLOAT LEAKS 2. INSPECT FLOAT ARM FOR ROUGHNESS OR GROOVING

INSTRUCTOR'S PLAN VII-D-3(S)
MANIPULATIVE LESSON

TASK:	REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT
AIM:	STUDENT WILL BE ABLE TO PROPERLY REASSEMBLE THE ONE BARREL CARBURETOR AND MAKE INITIAL ADJUSTMENTS THAT ARE REQUIRED IN PREPARATION FOR FINAL TUNE UP ADJUSTMENT.
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES OR GLASSES, AND SPECIAL CARBURETOR TOOLS
MATERIALS:	CLEAN RAGS
TEACHING AIDS:	I. ED. II 7T, FIGS. 561-567
REFERENCES:	MANUFACTURER'S SERVICE MANUAL OF CARBURETOR AT HAND AUTOMECHANICS, GLENN, PP. 144-163 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29
PREREQUISITE EXPERIENCE OF THE LEARNER:	STUDENT MUST HAVE COMPLETED SATISFACTORILY PREVIOUS TASKS IN REMOVAL, DISASSEMBLY, CLEANING, AND INSPECTION OF CARBURETOR WITH THE APPROVAL OF THE INSTRUCTOR PRIOR TO REASSEMBLY OF THE CARBURETOR
CHECKING STANDARDS:	1. PROPER SELECTION OF TOOLS AND EQUIPMENT 2. PROPER USE AND CARE OF TOOLS 3. FOLLOW STEPS AND KEY POINTS 4. SAFETY PROCEDURES AND SHOP PRACTICES 5. DISPLAY CRAFTSMANLIKE ATTITUDE

I. PREPARATION (OF THE LEARNER - MOTIVATION)

UPON COMPLETION OF CLEANING AND EITHER REPLACEMENT OR REPAIR OF DAMAGEDPARTS, THE CARBURETOR IS READY TO BE REASSEMBLED. PROPER SEQUENCE OF STEPS AND CARE IN REASSEMBLING THE CARBURETOR IS VERY IMPORTANT TO THE PROPER OPERATION AND FUNCTION OF THE CARBURETOR. EACH PART MUST BE REASSEMBLED CAREFULLY AND EVERY INITIAL ADJUSTMENT MADE CORRECTLY. THIS LESSON WILL DEMONSTRATE THE CORRECT PROCEDURE FOR THE REASSEMBLY AND INITIAL ADJUSTMENTS TO BE MADE ON THE ONE BARREL CARBURETOR.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. ASSEMBLE THROTTLE BODY FLANGE ASSEMBLY	1. INSPECT THROTTLE SHAFT FOR WEAR IN THROTTLE BODY NOTE: REPLACE ASSEMBLY IF WEAR IS EXCESSIVE 2. ATTACH THROTTLE PLATE TO THROTTLE SHAFT NOTE: POSITION THROTTLE PLATE ON THROTTLE SHAFT WITH THE NOTCH IN THE PLATE ALIGNED WITH THE SLOTTED IDLE PORT. IN THE THROTTLE BODY FLANGE 3. INSTALL IDLE SCREW AND SPRING NOTE: REPLACE IDLE SCREW IF DAMAGED TO INSURE CORRECT IDLE MIXTURE CONTROL 4. ADJUST IDLE SCREW LIGHTLY AGAINST SEAT CAUTION: BACK OFF NUMBER OF TURNS COUNTED AT DISASSEMBLY 5. INSTALL NEW PLASTIC CAP WITH TAB AGAINST STOP 6. ATTACH THROTTLE BODY TO MAIN BODY NOTE: USE NEW GASKETS CAUTION: TORQUE SCREWS TO THIRTY INCH POUNDS
2. ASSEMBLE CARBURETOR BOWL COVER	NOTE: BEFORE INSTALLING VACUUM PISTON ASSEMBLY IN BOWL COVER, BE SURE AND REMOVE ALL STAKING FROM RETAINER CAVITY 1. INSTALL SPRING AND PISTON IN VACUUM CYLINDER 2. SEAT RETAINER PROPERLY 3. STAKE RETAINER WITH PROPER TOOL 4. TEST ACCELERATOR PUMP DISCHARGE CHECK BALL SEAT 5. COAT PUMP PISTON WITH OIL 6. FILL FUEL BOWL WITH CLEAN GASOLINE 7. INSTALL ACCELERATOR PUMP DISCHARGE CHECK BALL AND WEIGHT 8. HOLD DISCHARGE CHECK BALL DOWN

WITH A SMALL BRASS ROD

9. OPERATE PUMP PLUNGER BY HAND
NOTE: IF CHECK BALL AND SEAT ARE LEAKING, NO RESISTANCE WILL BE EXPERIENCED WHEN OPERATING PLUNGER. IF VALVE IS LEAKING REMOVE WEIGHT AND STAKE BALL. USE A SUITABLE DRIFT PUNCH. EXERCISE CARE WHEN STAKING BALL TO AVOID DAMAGING BORE CONTAINING PUMP WEIGHT. AFTER STAKING OLD BALL, REMOVE AND REPLACE WITH NEW BALL FROM REPAIR KIT. INSTALL WEIGHT AND CHECK FOR LEAKS. IF NO LEAKS, REMOVE CHECK BALL AND WEIGHT FROM MAIN BODY
10. INSTALL ACCELERATOR PUMP, PUMP OPERATING ROD, AND ROD RETAINER IN BOWL COVER

3. ASSEMBLE CARBURETOR MAIN BODY

1. INSTALL POWER VALVE ASSEMBLY IN BOTTOM OF FUEL BOWL AND TIGHTEN SECURELY
CAUTION: BE SURE NEEDLE VALVE OPERATES FREELY
2. INSTALL MAIN METERING JET (USE SPECIAL TOOL)
3. INSTALL FLOAT SHAFT AND POSITION ASSEMBLY IN FLOAT SHAFT CRADLE
4. INSERT RETAINING SPRING
CAUTION: CHECK FLOAT ALIGNMENT TO PREVENT BINDING
NOTE: A NITROPHYL FLOAT CAN BE CHECKED FOR FULL ABSORPTION BY LIGHTLY SQUEEZING BETWEEN FINGERS. IF WETNESS APPEARS ON SURFACE OR FLOAT FEELS HEAVY (CHECK WITH KNOWN FLOAT) REPLACE FLOAT ASSEMBLY
5. PLACE A NEW GASKET ON FUEL INLET FITTING
6. INSTALL ASSEMBLY INTO MAIN BODY
7. TIGHTEN SECURELY
NOTE: WHEN REPLACING NEEDLE AND SEAT ASSEMBLY (INLET FITTING), FLOAT LEVEL MUST ALSO BE CHECKED,

AS DIMENSIONAL DIFFERENCE BETWEEN OLD AND NEW ASSEMBLIES MAY CHANGE THE FLOAT LEVEL

8. TO ADJUST FLOAT LEVEL PLACE BOWL COVER GASKET ON TOP OF FUEL BOWL
9. HOLD GASKET IN PLACE AND INVERT BOWL
10. PLACE A STRAIGHT EDGE ACROSS GASKET SURFACE
    NOTE: THE PORTION OF FLOAT LUNGS FARTHEST FROM FUEL INLET SHOULD JUST TOUCH STRAIGHT EDGE. IF ADJUSTMENT IS NECESSARY, BEND TANG TO OBTAIN THIS ADJUSTMENT
11. INSERT CHECK BALL AND WEIGHT INTO ACCELERATOR PUMP DISCHARGE WELL
12. CAREFULLY POSITION BOWL COVER ON TOP OF GASKET
    CAUTION: BE SURE LEADING EDGE OF ACCELERATOR PUMP CUP ARE NOT DAMAGED AS IT ENTERS PUMP BORE. BE CAREFUL NOT TO DAMAGE THE MAIN WELL TUBE
13. INSTALL BOWL COVER SCREWS
14. TIGHTEN ALTERNATELY, A LITTLE AT A TIME, TO COMPRESS GASKET EVENLY
15. INSTALL POSITIVE THROTTLE RETURN SPRING
16. INSTALL FAST IDLE CAM AND LINK
17. INSTALL CHECK VACUUM DIAPHRAGM
18. INSTALL BOWL VENT ASSEMBLY

4. ADJUST CARBURETOR CHOKE UNLOADER WIDE OPEN KICK

1. HOLD THROTTLE VALVES IN WIDE OPEN POSITION
2. INSERT SPECIFIED GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND INNER WALL OF AIR HORN
   NOTE: WITH A FINGER SLIGHTLY PRESSING AGAINST CONTROL LEVER, A SLIGHT DRAG SHOULD BE FELT AS GAUGE IS BEING WITHDRAWN. IF AN ADJUSTMENT IS NECESSARY, BEND UNLOADER TANG ON THROTTLE LEVER UNTIL CORRECT OPENING HAS BEEN OBTAINED

3. INSPECT CHOKE VACUUM DIAPHRAGM FITTING TO INSURE THAT PASSAGE IS NOT PLUGGED
4. TEST CHOKE DIAPHRAGM FOR INTERNAL LEAK
   a. DEPRESS DIAPHRAGM STEM
   b. PLACE FINGER OVER VACUUM FITTING TO SEAL OPENING
   c. RELEASE DIAPHRAGM STEM
   d. IF THE STEM MOVES MORE THAN 1/16 INCH IN 10 SECONDS THE ASSEMBLY MUST BE REPLACED

5. ADJUST CHOKE VACUUM KICK

1. DISCONNECT CHOKE VACUUM DIAPHRAGM HOSE AT CARBURETOR
2. APPLY FIFTEEN OR MORE INCHES OF VACUUM TO DIAPHRAGM WITH HAND OPERATED VACUUM PUMP
3. INSERT SPECIFIED GAUGE BETWEEN TOP OF CHOKE VALVE AND WALL OF AIR HORN
4. APPLY SUFFICIENT CLOSING PRESSURE ON LEVER TO WHICH CHOKE ROD ATTACHES TO PROVIDE A MINIMUM CHOKE VALVE OPENING WITHOUT DISTORTION OF DIAPHRAGM LINE
   NOTE: CYLINDRICAL STEM OF DIAPHRAGM WILL EXTEND AS INTERNAL SPRING IS COMPRESSED. THIS SPRING MUST BE FULLY COMPRESSED FOR PROPER MEASUREMENT OF VACUUM KICK ADJUSTMENT
5. ADJUSTMENT IS NECESSARY IF SLIGHT DRAG IS NOT FELT WHEN REMOVING GAUGE
6. SHORTEN OR LENGTHEN DIAPHRAGM LINK TO OBTAIN CORRECT CHOKE VALVE OPENING
   NOTE: DO NOT APPLY TWISTING OR BENDING FORCE TO DIAPHRAGM
7. REINSTALL VACUUM HOSE ON CORRECT FITTING

6. ADJUST BOWL VENT VALVE

1. PLACE THROTTLE AT CURB IDLE POSITION
2. MEASURE DISTANCE FROM COVER SUP-

		PORT SURFACE DOWN TO FLAT ON PLASTIC BOWL VENT LEVER NOTE: IF ADJUSTMENT IS NECESSARY, TURN BOWL VENT LEVER ADJUSTING SCREW a. USE PROPER SCREWDRIVER b. TURN IN PROPER DIRECTION TO OBTAIN CORRECT MEASUREMENT
7.	ADJUST ACCELERATOR PUMP PISTON STROKE	1. POSITION THROTTLE IN CURB IDLE POSITION 2. PLACE ACCELERATOR PUMP OPERATING LINK IN PROPER SLOT IN THROTTLE LEVER 3. MEASURE LENGTH OF OPERATING LINK 4. SHORTEN OR LENGTHEN TO OBTAIN SPECIFICATIONS
8.	ADJUST FAST IDLE CAM POSITION	1. PLACE FAST IDLE SPEED ADJUSTING SCREW ON SECOND HIGHEST STEP OF FAST IDLE CAM 2. MOVE CHOKE VALVE TOWARD CLOSED POSITION WITH LIGHT PRESSURE ON THE CHOKE CONTROL LEVEL 3. INSERT SPECIFIED GAUGE BETWEEN TOP OF CHOKE VALVE AND WALL OF AIR HORN 4. BEND UPPER ANGLE OF FAST IDLE LINK TO OBTAIN PROPER SETTING
9.	CLEAN WORK STATION	1. PLACE DIRTY RAGS AND EMPTY PARTS BOXES IN PROPER DISPOSAL CONTAINERS 2. CLEAN WORK BENCH 3. SWEEP WORK AREA 4. PREPARE FOR INSTALLATION OF CARBURETOR

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. FURNISH STUDENTS WITH JOB AND TASK SHEETS.
2. STUDENTS TO PRACTICE BY REASSEMBLING CARBURETOR.
3. OBSERVE AND INSPECT PROCEDURE. RETEACH IF NEED ARISES.
4. STUDENT TO GIVE BACK STEPS AND KEY POINTS AS THEY PERFORM TASK.

IV. VERIFICATION AND OR/EVALUATION (CHECK ON STUDENT'S ABILITY)

1. STUDENTS PUT ON THEIR OWN TO PERFORM TASK.
2. PROPER ASSEMBLING OF CARBURETOR BY STUDENT.
3. OBSERVANCE OF SAFETY HABITS AND CRAFTSMANSHIP.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. REPEAT EACH STEP IN STAGE II
2. ASK QUESTION OF THE STUDENTS
2. EMPHASIZE SAFETY AND KEY POINTS

SUGGESTED READING FOR THE STUDENT:

AUTOMECHANICS, GLENN, PP. 144-168
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29

THE NEXT LESSON IS: VII-D-4(S), "INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENTS ON A ONE BARREL CARBURETOR"

JOB SHEET
ON
FUEL SYSTEM

VII-D-3(J)

JOB:	REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT	
MATERIALS:	CLEAN RAGS	
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES OR GLASSES AND SPECIAL CARBURETOR TOOLS	
GENERAL INSTRUCTIONS:	SAFETY GOGGLES OR GLASSES MUST BE WORN AT ALL TIMES TO PROTECT EYES FROM GASOLINE, CLEANING CHEMICALS, AND DIRT	
PROCEDURES AND/OR TASKS:	VII-D-3(TS)	ASSEMBLE THROTTLE BODY FLANGE ASSEMBLY
	VII-D-3a(TS)	ASSEMBLE ONE BARREL CARBURETOR BOWL COVER
	VII-D-3b(TS)	ASSEMBLE ONE BARREL CARBURETOR MAIN BODY
	VII-D-3c(TS)	ADJUST UNLOADER WIDE OPEN KICK
	VII-D-3d(TS)	ADJUST CHOKE VACUUM KICK
	VII-D-3e(TS)	ADJUST BOWL VENT VALVE
	VII-D-3f(TS)	ADJUST ACCELERATOR PUMP PISTON
	VII-D-3g(TS)	ADJUST FAST IDLE CAM POSITION

CHECK POINT:

1. HAVE INSTRUCTOR CHECK CARBURETOR FOR PROPER ADJUSTMENTS
2. CORRECT SELECTION OF TOOLS
3. ADHERENCE TO SAFETY PROCEDURES AND PRACTICE
4. CHECK WITH INSTRUCTOR BEFORE PROCEEDING TO NEXT TASK

TASK: ASSEMBLE THROTTLE BODY FLANGE ASSEMBLY

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK THROTTLE SHAFT	1. CHECK THROTTLE SHAFT FOR EXCESSIVE WEAR IN BODY NOTE: IF WEAR IS EXTREME, IT IS RECOMMENDED THAT CARBURETOR ASSEMBLY BE REPLACED RATHER THAN INSTALLING A NEW SHAFT IN THE OLD BODY
2. INSTALL IDLE SCREWS	1. PLACE SPRING ON IDLE SCREW 2. INSTALL IDLER SCREW IN BODY NOTE: THE TAPERED PORTION OF THE IDLE SCREW MUST BE STRAIGHT AND SMOOTH. IF TAPERED PORTION IS GROOVED OR RIDGED, A NEW SCREW SHOULD BE INSTALLED TO INSURE HAVING CORRECT IDLE MIXTURE CONTROL 3. TURN SCREW (CLOCKWISE) LIGHTLY AGAINST SEAT a. USE FINGERS b. DO NOT USE SCREWDRIVER 4. BACK OFF NUMBER OF TURNS COUNTED AT DISASSEMBLY 5. INSTALL NEW PLASTIC CAP WITH TAB AGAINST STOP
3. ATTACH THROTTLE BODY TO MAIN BODY	1. USING NEW GASKET INSTALL THROTTLE BODY TO MAIN BODY 2. INSTALL SCREWS a. USE SOCKET SCREWDRIVER AND TORQUE WRENCH b. TIGHTEN TO THIRTY INCH POUNDS

TASK: ASSEMBLE ONE BARREL CARBURETOR BOWL COVER

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, CLEAN RAGS, SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL VACUUM PISTON ASSEMBLY	NOTE: BEFORE INSTALLING VACUUM PISTON ASSEMBLY IN BOWL COVER, BE SURE AND REMOVE ALL STAKING FROM RETAINER CAVITY 1. INSTALL SPRING AND PISTON IN VACUUM CYLINDER 2. SEAT RETAINER PROPERLY 3. STAKE RETAINER WITH PROPER TOOL
2. TEST ACCELERATOR PUMP CHECK BALL SEAT	1. COAT PUMP PISTON WITH OIL 2. FILL FUEL BOWL WITH CLEAN GASOLINE 3. INSTALL ACCELERATING PUMP DISCHARGE CHECK BALL AND WEIGHT 4. HOLD DISCHARGE CHECK BALL DOWN WITH A SMALL BRASS ROD 5. OPERATE PUMP PLUNGER BY HAND NOTE: IF CHECK BALL AND SEAT ARE LEAKING, NO RESISTANCE WILL BE EXPERIENCED WHEN OPERATING PLUNGER. IF VALVE IS LEAKING REMOVE WEIGHT AND STAKE BALL. USE A SUITABLE DRIFT PUNCH. EXERCISE CARE WHEN STAKING BALL TO AVOID DAMAGING BORE CONTAINING PUMP WEIGHT. AFTER STAKING OLD BALL, REMOVE AND REPLACE WITH NEW BALL FROM REPAIR KIT. INSTALL WEIGHT AND CHECK FOR LEAK. IF NO LEAKS REMOVE CHECK BALL AND WEIGHT FROM MAIN BODY 6. INSTALL ACCELERATOR PUMP, PUMP OPERATING ROD, AND RETAINER IN BOWL COVER

TASK: ASSEMBLE ONE BARREL CARBURETOR MAIN BODY

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PLACE CARBURETOR ON STAND	1. INSTALL POWER VALVE ASSEMBLY IN BOTTOM OF FUEL BOWL a. USE PROPER SPECIAL TOOL b. TURN VALVE ASSEMBLY TO RIGHT (CLOCKWISE) c. TIGHTEN SECURELY CAUTION: BE SURE NEEDLE VALVE OPERATES FREELY AFTER TIGHTENING 2. INSTALL MAIN METERING JET a. USE PROPER SPECIAL TOOL b. TURN TO RIGHT (CLOCKWISE) c. TIGHTEN SECURELY CAUTION: BE SURE NEEDLE VALVE OPERATES FREELY AFTER TIGHTENING
2. INSTALL FLOAT ASSEMBLY	1. INSTALL FLOAT SHAFT IN FLOAT ASSEMBLY 2. POSITION FLOAT ASSEMBLY IN FLOAT SHAFT CRADLE 3. INSERT RETAINING SPRING a. USE MEDIUM SCREWDRIVER b. SNAP SPRING INTO PLACE CAUTION: ALIGN FLOAT ASSEMBLY TO PREVENT BINDING
3. INSTALL FUEL INLET FITTING	1. PLACE A NEW GASKET ON FUEL INLET FITTING 2. POSITION FLOAT ASSEMBLY IN FLOAT SHAFT CRADLE 3. INSERT RETAINING SPRING a. USE PROPER BOX WRENCH b. TURN FITTING TO RIGHT (CLOCKWISE) c. TIGHTEN SECURELY

STEPS	KEY POINTS
	NOTE: WHEN REPLACING NEEDLE AND SEAT ASSEMBLY (INLET FITTING) FLOAT LEVEL MUST ALSO BE CHECKED
4. ADJUST FLOAT LEVEL	1. PLACE NEW GASKET ON TOP OF FUEL BOWL 2. HOLD GASKET IN PLACE AND INVERT FUEL BOWL 3. PLACE STRAIGHT EDGE ACROSS GASKET SURFACE 4. THE PORTION OF FLOAT LUNGS FARTHEST FROM FUEL INLET SHOULD JUST TOUCH STRAIGHT EDGE 5. BEND FLOAT TANG TO ADJUST
5. INSTALL CHECK BALL AND WEIGHT	1. INSERT CHECK BALL INTO ACCELERATOR PUMP WELL 2. ALIGN CHECK BALL WEIGHT AND DROP INTO WELL
6. INSTALL BOWL COVER	1. CAREFULLY POSITION BOWL COVER POSITIVE BOWL ON TOP OF GASKET CAUTION: BE SURE LEADING EDGE OF ACCELERATOR PUMP CUP IS NOT DAMAGED AS IT ENTERS BORE. BE CAREFUL NOT TO DAMAGE MAIN WELL TUBE 2. INSTALL BOWL COVER SCREWS ALTERNATELY, A LITTLE AT A TIME, TO COMPRESS GASKET EVENLY a. USE PROPER SCREWDRIVER b. TURN SCREWS TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS
7. ATTACH OUTSIDE PARTS TO CARBURETOR	1. INSTALL POSITIVE THROTTLE RETURN SPRING 2. INSTALL FAST IDLE CAM AND LINK 3. SECURE WITH NUT AND LOCKWASHER a. USE PROPER SOCKET AND TORQUE WRENCH b. TURN NUT TO RIGHT (CLOCKWISE) c. TIGHTEN TO SPECIFICATIONS 4. INSTALL CHOKE DIAPHRAGM 5. SECURE WITH PROPER SCREWS a. USE PROPER SCREWDRIVER b. TURN SCREWS TO RIGHT (CLOCKWISE)

STEPS	KEY POINTS
	c. TIGHTEN SECURELY
	6. INSTALL BOWL VENT ASSEMBLY
	7. SECURE WITH MOUNTING SCREW
	a. USE PROPER SCREWDRIVER
	b. TURN SCREW TO RIGHT (CLOCKWISE)

TASK SHEET VII-D-3c(TS)

TASK: ADJUST ONE BARREL CARBURETOR UNLOADER WIDE OPEN KICK

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION CARBURETOR LINKAGE	1. HOLD THROTTLE VALVE IN WIDE OPEN POSITION 2. INSERT SPECIFIED GAUGE BETWEEN EDGE OF CHOKE VALVE AND INNER WALL OF AIR HORN 3. APPLY SLIGHT PRESSURE AGAINST CONTROL LEVER NOTE: A SLIGHT DRAG SHOULD BE FELT AS GAUGE IS WITHDRAWN
2. ADJUST CHOKE UNLOADED WIDE OPEN KICK	1. BEND UNLOADED TANG ON THROTTLE LEVER 2. REMOVE GAUGE WHEN ADJUST REACHES SPECIFICATION
3. INSPECT CHOKE DIAPHRAGM	1. CHECK CHOKE DIAPHRAGM FITTING OPENING 2. TEST CHOKE DIAPHRAGM FOR INTERNAL LEAK a. DEPRESS DIAPHRAGM STEM b. PLACE FINGER OVER FITTING TO SEAL OPENING c. IF STEM MOVES MORE THAN 1/16 INCH IN 10 SECONDS REPLACE ASSEMBLY

TASK SHEET VII-D-3d(TS)

TASK: ADJUST ONE BARREL CARBURETOR CHOKE VACUUM KICK

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, SPECIAL CARBURETOR TOOLS FOR CARBURETOR AT HAND

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE CHOKE LINKAGE	1. DISCONNECT CHOKE DIAPHRAGM VACUUM HOSE AT CARBURETOR 2. APPLY FIFTEEN OR MORE INCHES OF VACUUM TO DIAPHRAGM WITH HAND OPERATED PUMP
2. ADJUST CHOKE VALVE	1. INSERT SPECIFIED GAUGE BETWEEN TOP OF CHOKE VALVE AND WALL OF AIR HORN 2. APPLY SUFFICIENT CLOSING PRESSURE ON LEVER TO WHICH CHOKE ROD ATTACHES TO PROVIDE A MINIMUM CHOKE VALVE OPENING WITHOUT DISTORTION OF DIAPHRAGM LINES NOTE: CYLINDRICAL STEM OF DIAPHRAGM WILL EXTEND AS INTERNAL SPRING IS COMPRESSED. THIS SPRING MUST BE FULLY COMPRESSED FOR PROPER MEASUREMENT OF VACUUM KICK ADJUSTMENT 3. SHORTEN OR LENGHTEN DIAPHRAGM LINK TO OBTAIN CORRECT CHOKE VALVE OPENING NOTE: DO NOT APPLY TWISTING OR BENDING FORCE TO DIAPHRAGM 4. REINSTALL VACUUM HOSE ON CORRECT FITTING

TASK: ADJUST BOWL VENT VALVE ON ONE BARREL CARBURETOR

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, 1/2" WIDE 6" RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION CARBURETOR LINKAGE	1. PLACE THROTTLE AT CURB IDLE POSITION 2. MEASURE DISTANCE FROM COVER SUPPORT SURFACE DOWN TO FLAT PLACE ON PLASTIC BOWL VENT LEVER
2. ADJUST DISTANCE	1. TURN ADJUSTING SCREW IN PROPER DIRECTION a. USE CORRECT SCREWDRIVER b. TURN COUNTER CLOCKWISE OR CLOCKWISE AS REQUIRED 2. SET TO SPECIFICATIONS

TASK SHEET VII-D-3f(TS)

TASK: ADJUST ACCELERATOR PUMP PISTON STROKE ON ONE BARREL CARBURETOR

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, 1/2" WIDE RULER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION ACCELERATOR LINKAGE	1. PLACE THROTTLE IN CURB IDLE POSITION 2. PLACE ACCELERATOR PUMP OPERATING LINK IN PROPER SLOT IN THROTTLE LEVER
2. ADJUST LEVER	1. MEASURE LENGTH OF OPERATING LINK 2. SHORTEN OR LENGTHEN LINK TO OBTAIN SPECIFICATIONS

TASK: ADJUST FAST IDLE CAM POSTION ON ONE BARREL CARBURETOR

JOB: REASSEMBLE AND MAKE INITIAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION CARBURETOR LINKAGE	1. PLACE FAST IDLE SPEED ADJUSTING SCREW ON SECOND HIGHEST STEP OF FAST IDLE CAM 2. MOVE CHOKE VALVE TOWARD CLOSED POSITION WITH LIGHT PRESSURE ON CHOKE CONTROL LEVER
2. POSITION FAST IDLE CAM	1. INSERT SPECIFIED GAUGE BETWEEN TOP OF CHOKE VALVE AND WALL OF AIR HORN 2. BEND UPPER ANGLE OF FAST IDLE LINK TO OBTAIN PROPER SETTING

INSTRUCTOR'S PLAN VII-D-4(S)
MANIPULATIVE LESSON

TASK:	INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT
AIM:	STUDENT WILL BE ABLE TO PROPERLY INSTALL CARBURETOR ON VEHICLE AND MAKE FINAL ADJUSTMENTS IN ORDER TO INSURE THE BEST PERFORMANCE AND ECONOMY IN OPERATION OF THE VEHICLE
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GOGGLES OR GLASSES, SPECIAL CARBURETOR TOOLS, SMALL ADJUSTABLE WRENCH, BATTERY PLIERS, AND TACHOMETER
MATERIALS:	CLEAN RAGS, SEAT COVER, AND FENDER COVERS
TEACHING AIDS:	I. ED. II 7T, FIGS. 561-567
REFERENCES:	MANUFACTURER'S SERVICE MANUAL OF CARBURETOR AT HAND AUTOMECHANICS, GLENN, PP. 144-168 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266 AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE STUDENT MUST HAVE SUCCESSFULLY COMPLETED THOSE TASKS IN VII-D-3 ON THE REASSEMBLY AND INITIAL CARBURETOR ADJUSTMENTS
CHECKING STANDARDS:	1. PROPER INSTALLATION OF CARBURETOR ON VEHICLE 2. PROPER SELECTION, USE, AND CARE OF TOOLS 3. FINAL PERFORMANCE TEST UPON COMPLETION OF FINAL CARBURETOR ADJUSTMENT 4. SAFETY PROCEDURES AND SHOP PRACTICES 5. DISPLAY CRAFTSMANLIKE ATTITUDE

I. PREPARATION (OF THE LEARNER - MOTIVATION)

THE FINAL TASK IN THE OVERHAUL OF A ONE BARREL CARBURETOR IS THE INSTALLATION ON THE VEHICLE AND FINAL CARBURETOR ADJUSTMENTS. THIS TASK MUST BE PERFORMED PROPERLY TO INSURE CORRECT FUEL AIR RATIO SO AS TO GIVE BEST PERFORMANCE AND ECONOMY. THIS LESSON WILL DEMONSTRATE THE PROPER PROCEDURE FOR ADJUSTING THE CARBURETOR TO PROPER SPECIFICATIONS.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. REINSTALL CARBURETOR ON VEHICLE	1. INSPECT MATING SURFACES OF CARBURETOR AND INTAKE MANIFOLD

	NOTE: BE SURE BOTH SURFACES ARE CLEAN AND FREE OF NICKS, BURRS, OR ANY OTHER DAMAGE 2. PLACE A NEW FLANGE GASKET ON MANIFOLD SURFACE CAUTION: SOME FLANGE GASKETS CAN BE INSTALLED UPSIDE DOWN OR BACKWARDS. TO PREVENT THIS, MATCH HOLES IN GLANGE GASKET WITH HOLES ON BOTTOM OF CARBURETOR, THEN PLACE GASKET PROPERLY ON INTAKE MANIFOLD SURFACE 3. CAREFULLY PLACE CARBURETOR ON MANIFOLD WITHOUT TRAPPING CHOKE ROD UNDER CARBURETOR LINKAGE 4. INSTALL CARBURETOR NUTS OR BOLTS 5. TIGHTEN ALTERNATELY, A LITTLE AT A TIME, TO COMPRESS FLANGE GASKET EVENLY 6. DRAW DOWN TIGHTLY TO PREVENT VACUUM LEAK BETWEEN CARBURETOR AND INTAKE MANIFOLD 7. CONNECT THROTTLE, CHOKE LINKAGE, AND INLET LINE NOTE: CHECK CAREFULLY FOR WORN OR LOOSE CONNECTIONS NOTE: MAKE SURE CHOKE PLATE OPENS AND CLOSES FULLY WHEN OPERATED. CHECK TO SEE THAT FULL THROTTLE IS OBTAINED
2. INSTALL AIR CLEANER	1. REFER TO PROPER DIAGRAMS AND INSTALL VACUUM HOSES 2. SECURE AIR CLEANER WITH WING NUT
3. CONNECT BATTERY CABLES	1. CONNECT POSITIVE CABLES 2. CONNECT GROUND CABLE 3. TIGHTEN CABLE TERMINALS
4. PREPARE VEHICLE FOR FINAL CARBURETOR ADJUSTMENTS	1. REPLACE GAS TANK CAP 2. START ENGINE 3. RUN ENGINE UNTIL NORMAL OPERATING TEMPERATURE IS REACHED 4. TURN OFF IGNITION 5. PLACE TRANSMISSION IN NEUTRAL 6. SET PARKING BRAKE
5. REMOVE AIR CLEANER	1. REFER TO: VII-A-1(TS) "REMOVE AIR CLEANER FROM VEHICLE"

6. ADJUST FAST IDLE SPEED	1. COVER ALL VACUUM FITTINGS 2. CONNECT TACHOMETER 3. OPEN THROTTLE AND CLOSE CHOKE 4. CLOSE THROTTLE 5. PLACE FAST IDLE SCREW ON HIGHEST SPEED STEP 6. MOVE FAST IDLE CAM UNTIL SCREW DROPS TO SECOND HIGHEST SPEED STEP 7. START ENGINE 8. ADJUST RPM TO SPECIFICATIONS
7. ADJUST CURB IDLE SPEED	1. RELEASE FAST IDLE CAM 2. TURN CURB IDLE ADJUSTING SCREW IN PROPER DIRECTION 3. SET ENGINE RPM TO SPECIFICATIONS
8. REMOVE VEHICLE	1. REMOVE TACHOMETER 2. RECONNECT VACUUM HOSES 3. INSTALL AIR CLEANER REFER TO: VII-A-1(TS) 4. PLACE VEHICLE IN ASSIGNED PARKING AREA
9. CLEAN WORK STATION	1. CLEAN TOOLS 2. RETURN TOOLS TO STORAGE AREA 3. CLEAN BENCHES AND FLOOR AS IN PREVIOUS LESSONS

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. FURNISH STUDENTS WITH JOB AND TASK SHEETS.
2. STUDENTS TO PRACTICE ON TASKS.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

1. PERFORMANCE TEST ON OPERATION OF VEHICLE AFTER JOB COMPLETED.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. EMPHASIZE SAFETY WORK HABITS.
2. POINT OUT STEP BY STEP PROCEDURE FOR CARBURETOR OVERHAUL.
3. REVIEW TASK OF CARBURETOR ADJUSTMENTS.

SUGGESTED READING FOR STUDENTS:

AUTOMECHANICS, GLENN, PP. 144-168
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 217-266
AUTO SERVICE AND REPAIR, STOCKEL, PP. 20-16 TO 20-29

THE NEXT LESSON IS: VII-E-1(IS), "SERVICE HEAT RISER"

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JOB SHEET
ON
FUEL SYSTEM

VII-D-4(J)

JOB:	INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT	
MATERIALS:	CLEAN RAGS, SEAT COVER, AND FENDER COVER	
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, SAFETY GLASSES OR GOGGLES, SPECIAL CARBURETOR TOOLS, SMALL ADJUSTABLE WRENCH, BATTERY PLIERS, AND TACHOMETER	
GENERAL INSTRUCTIONS:	SAFETY GLASSES OR GOGGLES MUST BE WORN AT ALL TIMES TO PROTECT EYES	
PROCEDURES AND/OR TASKS:	VII-D-4(TS)	REINSTALL CARBURETOR ON VEHICLE
	VII-A-1b(TS)	INSTALL AIR CLEANER ON CARBURETOR
	VII-A-1c(TS)	CONNECT BATTERY CABLES
	VII-D-4a(TS)	PREPARE VEHICLE FOR FINAL CARBURETOR ADJUSTMENT
	VII-A-1a(TS)	REMOVE AIR CLEANER
	VII-D-4b(TS)	ADJUST FAST IDLE SPEED
	VII-C-4c(TS)	ADJUST CURB IDLE SPEED
	VII-A-1c(TS)	MAKE VEHICLE READY

CHECK POINTS:

1. HAVE INSTRUCTOR CHECK FINAL CARBURETOR ADJUSTMENT
2. PROPER SELECTION AND USE OF TOOLS
3. ADHERENCE TO SAFETY PROCEDURE AND PRACTICES
4. CRAFTSMAN LIKE PERFORMANCES AND APPRECIATION FOR TOOLS, WORKMANSHIP, AND STANDARDS

TASK: REINSTALL ONE BARREL CARBURETOR ON VEHICLE

JOB: INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE CARBURETOR AND INTAKE MANIFOLD	1. CLEAN MATING SURFACES 2. INSTALL PROPER NEW GASKET ON MANIFOLD CAUTION: SOME FLANGE GASKETS CAN BE INSTALLED UPSIDE DOWN OR BACKWARDS 3. MATCH HOLES IN FLANGE GASKET WITH HOLES ON BOTTOM OF CARBURETOR 4. PLACE GASKET PROPERLY ON INTAKE MANIFOLD SURFACE
2. INSTALL CARBURETOR	1. CAREFULLY PLACE CARBURETOR ON MANIFOLD WITHOUT TRAPPING CHOKE ROD UNDER CARBURETOR LINKAGE 2. INSTALL CARBURETOR NUTS OR BOLTS 3. TIGHTEN ALTERNATELY, A LITTLE AT A TIME, TO COMPRESS FLANGE GASKET EVENLY a. USE PROPER BOX WRENCH b. TURN NUTS OR BOLTS TO RIGHT (CLOCKWISE) c. TIGHTEN SECURELY 4. CONNECT THROTTLE LINKAGE a. USE THIN NOSE PLIERS b. RETAIN FUEL LINE FITTING c. TURN LINE NUT TO RIGHT (CLOCKWISE) d. TIGHTEN SECURELY NOTE: CHECK CAREFULLY FOR WORN OR LOOSE CONNECTIONS. MAKE SURE CHOKE PLATE OPENS AND CLOSES FULLY WHEN OPERATED. CHECK TO SEE THAT FULL THROTTLE IS OBTAINED

TASK: PREPARE VEHICLE FOR FINAL ONE BARREL CARBURETOR ADJUSTMENTS

JOB: INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ENGINE PREPERATION	1. INSTALL GAS TANK CAP 2. START ENGINE 3. RUN ENGINE UNTIL NORMAL OPERATING TEMPERATURE IS REACHED 4. TURN OFF IGNITION
2. SAFETY	1. PLACE TRANSMISSION IN NEUTRAL 2. SET PARKING BRAKE

TASK SHEET VII-D-4b(TS)

TASK: ADJUST FAST IDLE SPEED ON ONE BARREL CARBURETOR

JOB: INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, TACHOMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE CARBURETOR	1. COVER ALL VACUUM FITTINGS a. USE TAPE TO COVER FITTINGS b. APPLY TAPE SECURELY 2. CONNECT TACHOMETER a. CONNECT POSITIVE LEAD TO NEGATIVE COIL LEAD b. CONNECT NEGATIVE LEAD TO GROUND 3. OPEN THROTTLE AND CLOSE CHOKE 4. CLOSE THROTTLE 5. PLACE FAST IDLE SCREW ON HIGHEST SPEED STEP 6. MOVE FAST IDLE CAM UNTIL SCREW DROPS IN SECOND HIGHEST SPEED STEP 7. START ENGINE
2. ADJUST FAST IDLE SPEED	1. MOVE FAST IDLE ADJUSTING SCREW a. TURN PROPER DIRECTION b. SET RPM TO SPECIFICATIONS 2. CLOSE AND RELEASE CHOKE VALVE

TASK: ADJUST CURB IDLE SPEED ON ONE BARREL CARBURETOR

JOB: INSTALL AND MAKE FINAL CARBURETOR ADJUSTMENT

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, SAFETY GOGGLES, CLEAN RAGS, TACHOMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE ENGINE	1. START ENGINE 2. CONNECT TACHOMETER a. CONNECT POSITIVE LEAD TO NEGATIVE COIL LEAD b. CONNECT NEGATIVE LEAD TO GROUND
2. ADJUST CARBURETOR	1. RELEASE FAST IDLE CAM 2. MOVE IDLE SPEED ADJUSTING SCREW a. TURN IN PROPER DIRECTION b. SET ENGINE RPM TO SPECIFICATIONS

INSTRUCTOR'S PLAN VII-E-1(I)
INFORMATIONAL LESSON

SUBJECT:	HEAT RISER
AIM:	THE STUDENT WILL BE ABLE TO DESCRIBE THE FUNCTION OF A HEAT RISER.
TEACHING AIDS:	TRANSPARENCY I. ED. II 7T, FIG. 568 HEAT RISER OR HEAT CONTROL VALVE CHALKBOARD
MATERIALS:	CHALK
REFERENCES:	AUTOMOTIVE MECHANICS, CROUSE, PP. 161-163 AUTOMECHANICS, GLENN, P. 101 AUTO SERVICE AND REPAIR, STOCKEL, CH. 33 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 237-238
PREREQUISITE EXPERIENCE OF THE LEARNER:	THE STUDENT SHOULD HAVE SATISFACTORILY COMPLETED THE PRECEDING LESSONS ON CARBURETION.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

AS WE KNOW BY NOW, THERE ARE MANY CHECK, CONTROL, AND ASSIST DEVICES BUILT INTO AN AUTOMOTIVE ENGINE. IN THIS LESSON, WE WILL LEARN ABOUT A MECHANISM IN THE EXHAUST SYSTEM WHICH HELPS THE FUEL SYSTEM DO A BETTER JOB: THE HEAT RISER OR HEAT CONTROL VALVE.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PURPOSE OF HEAT RISER	1. PROVIDES HEATING OF FUEL-AIR MIXTURE DURING ENGINE WARM-UP 2. SPEEDS UP FUEL VAPORIZATION PROCESS 3. REDUCES CARBURETOR ICING AND ENGINE STALLING 4. PROMOTES SMOOTHER ACCELERATION
B. OPERATION	1. THERMOSTATIC SPRING CLOSES VALVE WHEN COLD
SHOW: TRANSPARENCY FIG. 568	2. VALVE FORCES HOT EXHAUST GAS TO CIRCULATE THROUGH PASSAGES OF

INTAKE MANIFOLD

3. GAS TRAVELS AROUND CARBURETOR BASE IN SOME DESIGNS
4. MAY THEN GO INTO EXHAUST MANIFOLD ON OTHER SIDE OR INTO EXHAUST PIPE
5. HEATING CAUSES SPRING TO OPEN VALVE GRADUALLY
6. SOME HAVE COUNTERWEIGHT TO HELP OPEN VALVE
7. ALLOWS HOT GAS DIRECTLY INTO EXHAUST SYSTEM AFTER ENGINE WARMED UP

C. LOCATION

1. UNIT USUALLY BUILT INTO EXHAUST MANIFOLD
2. POSITIONED IN PASSAGE CONNECTING INTAKE AND EXHAUST MANIFOLDS
3. ENGINES WITH TWO EXHAUST MANIFOLDS HAVE ONLY ONE
4. SOME LOCATED BETWEEN EXHAUST PIPE AND EXHAUST MANIFOLD

D. MALFUNCTIONS

1. DISTORTION OF SPRING MAY CAUSE FAILURE
2. LEAD SALTS AND CARBON CAN CAUSE VALVE TO FREEZE OR STICK
   a. VALVE STUCK IN OPEN POSITION MAY CAUSE:
      (1) DILUTION OF CRANKCASE OIL
      (2) ICING-UP OF CARBURETOR
      (3) SLOW WARM-UP
      (4) STALLING
      (5) POOR ACCELERATION
   b. VALVE STUCK IN CLOSED POSITION MAY CAUSE:
      (1) BURNED VALVES
      (2) OVERHEATING
      (3) DETONATION
      (4) WARPED MANIFOLD

E. SERVICE

1. VALVE SHAFT SHOULD BE FREE
2. THERMOSTATIC SPRING UNDISTORTED
3. SHAFT CLEANED AND LUBRICATED

CAUTION: SPECIAL HEAT RESISTANT LUBRICANT IS NECESSARY. NEVER USE ENGINE OIL

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK QUESTIONS TO STIMULATE CLASS DISCUSSION AND CHECK COMPREHENSION OF MATERIALS PRESENTED.

EXAMPLE: WHERE WOULD LEAD SALTS COME FROM THAT CAN CAUSE THE HEAT RISER TO STICK?

ANSWER: IT COMES FROM LEADED GASOLINE.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

QUESTIONS: SIMPLE RECALL

1.	THE HEAT RISER HELPS SPEED UP ____ OF FUEL.	VAPORIZATION
2.	BY HEATING THE FUEL CHARGE IT PROMOTES SMOOTHER ____.	ACCELERATION
3.	A ____ SPRING CLOSES THE VALVE WHEN COLD.	THERMOSTATIC
4.	HOT GAS IS FORCED THROUGH PASSAGES IN THE ____ MANIFOLD.	INTAKE
5.	IN SOME HEAT RISERS A ____ HELPS OPEN THE VALVE.	COUNTER-WEIGHT
6.	AFTER WARM-UP, GAS GOES INTO THE ____ PIPE.	EXHAUST
7.	A HEAT RISER IS USUALLY BUILT INTO THE ____ MANIFOLD.	EXHAUST
8.	BURNED ____ MAY BE CAUSED BY A HEAT RISER STUCK IN A CLOSED POSITION.	VALVES
9.	DETONATION MAY BE CAUSED BY A HEAT RISER STUCK IN A/AN ____ POSITION.	CLOSED
10.	LEAD SALTS AND ____ CAN CAUSE A VALVE TO STICK.	CARBON

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

THE HEAT RISER PLAYS AN IMPORTANT PART IN THE OPERATION OF A COLD ENGINE BY PROVIDING HEAT TO VAPORIZE GASOLINE MORE QUICKLY.

A THERMOSTATIC SPRING AND COUNTERWEIGHT FUNCTION TO OPEN AND

CLOSE A VALVE WHICH DIRECTS HOT EXHAUST GAS TO AN AREA WHERE IT HEATS THE FUEL CHARGE GOING INTO THE CYLINDERS.

LOCATION OF THE UNIT IS USUALLY BETWEEN INTAKE AND EXHAUST MANIFOLDS, BUT SOME DESIGNERS PLACE IT IN THE CONNECTION BETWEEN EXHAUST PIPE AND EXHAUST MANIFOLD.

SPRING DISTORTION OR A STUCK VALVE ARE MOST COMMON CAUSES OF HEAT RISER MALFUNCTION. FAILURE OF THE RISER TO OPERATE CAN LEAD TO POOR ENGINE PERFORMANCE AND SERIOUS DAMAGE.

SUGGESTED READING FOR STUDENTS:

AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 287-292

THE NEXT LESSON IS: VII-E-2(I), "EXHAUST SYSTEM"

INSTRUCTOR'S PLAN VII-E-1(S)
MANIPULATIVE LESSON

TASK:	SERVICE HEAT RISER
AIM:	THE STUDENT WILL BE ABLE TO REMOVE, REPAIR, OR REPLACE MANIFOLD HEAT CONTROL VALVE AS AN ASSEMBLY, OR SERVICE COMPONENTS AS REQUIRED IN A SAFE AND EFFICIENT MANNER, EXERCISING MAXIMUM APPRECIATION FOR TOOLS, EQUIPMENT, AND CUSTOMER'S VEHICLE, PERFORMING WORK IN A CRAFTSMANLIKE MANNER, ACCORDING TO SPECIFICATIONS FOR MAKE AND MODEL BEING SERVICED
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, DROP LIGHT, FLOOR HOIST OR JACK, SAFETY STANDS, TORQUE WRENCH, FENDER COVERS, SEAT COVER, DRIP PAN, PARTS CLEANING BRUSH, BUSHING REAMER, ARC WELDER, WELDING RODS, WELDING HOOD
MATERIALS:	GASKETS, HEAT RISER LUBRICANT, CLEANING SOLVENT, CLEAN RAGS, AND PENETRATING OIL IN CONTAINER
TEACHING AIDS:	MANUFACTURER'S SERVICE MANUAL AND CHARTS
REFERENCES:	AUTOMECHANICS, GLENN, PP. 38-42 AUTO SERVICE AND REPAIR, STOCKEL, CH. 33 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 245-251
PREREQUISITE EXPERIENCE OF THE LEARNER:	MUST HAVE SATISFACTORILY PERFORMED THE PRECEDING TASK IN EXHAUST SYSTEM SERVICE ALONG WITH OTHER TASKS PERTAINING TO THE JOB.
CHECKING STANDARDS:	1. SELECTION OF TOOLS AND EQUIPMENT. 2. SECURE VEHICLE WITH SAFETY STANDS. 3. DISCONNECT ELECTRICAL AND MECHANICAL CONNECTIONS. 4. STORAGE OF REMOVED PARTS AND ACCESSORIES. 5. USE OF TOOLS AND EQUIPMENT. 6. CLEAN WORKING CONDITIONS. 7. MAINTAIN SAFETY STANDARDS.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

OPERATION OF THE MANIFOLD HEAT CONTROL VALVE OR HEAT RISER VALVE SHOULD BE INSPECTED PERIODICALLY. THE COUNTERWEIGHT SHOULD RESPOND WHEN ENGINE IS MOMENTARILY ACCELERATED. WHEN MAKING THIS TEST AND NO MOVEMENT IS OBSERVED, THE SHAFT OF HEAT RISER VALVE IS BINDING DUE TO ACCUMULATION OF DEPOSITS OR A WEAK OR BROKEN

THERMOSTAT. THE APPLICATION OF A SUITABLE MANIFOLD HEAT CONTROL VALVE SOLVENT, EVERY OIL CHANGE, TO BOTH ENDS OF MANIFOLD HEAT CONTROL SHAFT AT BUSHINGS, WILL KEEP VALVE WORKING FREELY. THE SOLVENT SHOULD BE APPLIED WHEN MANIFOLD IS COOL AND ALLOWED TO SOAK A FEW MINUTES TO DISSOLVE DEPOSITS. THE MANIFOLD HEAT CONTROL VALVE MUST BE FREE TO OPERATE FOR ENGINE TO PERFORM SATISFACTORILY DURING WARM UP. IF THE VALVE STICKS IN CLOSED POSITION IT CAN CAUSE ENGINE TO OVERHEAT.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. POSITION VEHICLE	1. IN WORK BAY, OVER FLOOR HOIST 2. COVER FENDERS AND SEAT WITH CLEAN COVERS 3. OPEN HOOD
2. PREPARE VEHICLE	1. DISCONNECT BATTERY GROUND CABLE 2. POSITION DROP LIGHT 3. PLACE TOOLS IN POSITION 4. PLACE GEAR SHIFT IN NEUTRAL POSITION 5. SET PARK BRAKE
3. INSPECT HEAT RISER VALVE	1. FREE MOVEMENT OF SHAFT 2. SPRING TENSION ON COUNTERWEIGHT 3. THERMOSTATIC CONTROL 4. OPENING AND CLOSING ACTION OF VALVE
4. LUBRICATE HEAT RISER	1. APPLY MANIFOLD HEAT CONTROL VALVE LUBRICANT TO ENDS OF CONTROL VALVE SHAFT AT BUSHINGS NOTE: LUBRICANT SHOULD BE APPLIED WHEN MANIFOLD IS COOL TO DISSOLVE DEPOSITS 2. SOAK SHAFT FOR SEVERAL MINUTES BEFORE MOVING VALVE 3. WORK VALVE BACK AND FORTH SEVERAL TIMES 4. CHECK FOR FREE MOVEMENT OF VALVE SHAFT IN BUSHINGS NOTE: IF VALVE MOVEMENT IS NOT FREE, REPLACE HEAT CONTROL VALVE ASSEMBLY.

		SOME MAKES AND MODELS REQUIRE REMOVAL OF EXHAUST MANIFOLD FOR HEAT RISER REPLACEMENT, SOME MODELS HAVE HEAT RISER OR MANIFOLD HEAT CONTROL VALVE ASSEMBLY INSTALLED AS A UNIT BETWEEN EXHAUST PIPE AND MANIFOLD. REPAIR MANUAL FOR VEHICLE BEING SERVICED SHOULD BE REFERRED TO
5.	REMOVE EXHAUST PIPE	1. REMOVE EXHAUST PIPE TO MANIFOLD ATTACHING BOLTS 2. REMOVE EXHAUST MANIFOLD TO CYLINDER HEAD ATTACHING BOLTS, NUTS, AND WASHERS 3. LIFT EXHAUST MANIFOLD FROM CYLINDER HEAD
6.	CLEAN AND INSPECT CYLINDER HEAD AND MANIFOLD	1. CLEAN MATING SURFACE ON CYLINDER HEAD 2. CLEAN MATING SURFACE OF EXHAUST MANIFOLD 3. CHECK EXHAUST MANIFOLD SURFACES FOR FLATNESS CAUTION: IF STUDS COME OUT OF CYLINDER HEAD WHEN NUTS WERE REMOVED, INSTALL NEW STUDS AND APPLY SEALER TO COARSE THREAD END TO PREVENT COOLANT LEAKS 4. CHECK EXHAUST MANIFOLD FOR CRACKS AND DISTORTION
7.	POSITION EXHAUST MANIFOLD	1. IN VISE OR HOLDING FIXTURE 2. POSITION VALVE PLATE 3. GRIND SPOT WELD FROM VALVE PLATE AND SHAFT
8.	REMOVE SHAFT ASSEMBLY	1. REMOVE COUNTERWEIGHT FROM SHAFT END 2. REMOVE SHAFT FROM MANIFOLD BUSHINGS 3. LIFT OUT VALVE PLATE
9.	REMOVE SHAFT BUSHINGS	1. PRESS OUT BUSHINGS AND SEALS FROM MANIFOLD 2. CLEAN BUSHING SEATS

10.	INSTALL BUSHING SEALS	1. PRESS CUP SEALS INTO MANIFOLD 2. CUPPED ENDS FACING OUTWARD 3. EXTEND SEALS .100 INCH INTO MANIFOLD
11.	INSTALL BUSHINGS	1. PRESS BUSHINGS INTO MANIFOLD 2. FLUSH WITH EXHAUST MANIFOLD OUTER EDGE
12.	REAM BUSHINGS	1. POSITION LINE REAMER INTO BUSHINGS 2. LINE REAM BUSHINGS AND SEALS 3. TEST FIT OF SHAFT IN BUSHINGS AND SEALS
13.	INSTALL COUNTERWEIGHT ON SHAFT	1. INSTALL VALVE STOP IN SLOT ON COUNTERWEIGHT 2. FACE LOOPED END OUTWARD 3. POSITION THERMOSTAT ON COUNTERWEIGHT 4. PRESS COUNTERWEIGHT ON SHAFT, FLUSH WITH SHAFT END
14.	INSTALL NEW SHAFT ASSEMBLY	1. POSITION THERMOSTAT SPRING 2. INSTALL SHAFT ASSEMBLY THROUGH OUTER BUSHING 3. POSITION VALVE PLATE 4. SLIDE SHAFT ASSEMBLY THROUGH BUSHINGS, SEALS, AND VALVE PLATE WITH CENTER STRAP FACING FLANGED END OF MANIFOLD
15.	SPOT WELD VALVE PLATE	1. ATTACH HOOK END OF THERMOSTATIC SPRING TO STOP PIN 2. POSITION COUNTERWEIGHT END OF SHAFT 3. CLOSE VALVE, AND CENTER BETWEEN SEALS 4. ARC WELD PLATE TO SHAFT CAUTION: ARC WELD GROUND MUST BE MADE AT COUNTERWEIGHT 5. CHECK FREE MOVEMENT OF SHAFT AND VALVE 6. INSTALL ANTIRATTLE SPRING
16.	INSTALL EXHAUST MANIFOLD	1. POSITION NEW GASKET ON MOUNTING STUDS 2. INSTALL EXHAUST MANIFOLD ON STUDS IN CYLINDER HEAD

		3. INSTALL ATTACHING NUTS AND TORQUE TO SPECIFICATIONS
17.	INSTALL EXHAUST PIPE	1. POSITION NEW GASKET (IF USED) OVER EXHAUST PIPE ATTACHING STUDS IN EXHAUST MANIFOLD 2. INSTALL EXHAUST PIPE TO MANIFOLD 3. INSTALL ATTACHING NUTS AND TORQUE TO SPECIFICATIONS
18.	CHECK HEAT RISER OPERATION	1. INSTALL BATTERY GROUND CABLE 2. START ENGINE 3. CHECK FOR CORRECT VALVE OPERATION 4. CHECK FOR EXHAUST LEAKS
19.	REMOVE VEHICLE	1. REMOVE FENDER COVERS 2. REMOVE ANY HAND PRINTS, OIL, OR GREASE FROM VEHICLE'S FINISH 3. PARK VEHICLE IN APPROVED AREA 4. CLEAN STEERING WHEEL AND REMOVE SEAT COVER
20.	CLEAN WORK STATION	1. CLEAN TOOLS AND EQUIPMENT AND RETURN TO STORAGE 2. CLEAN WORK BAY AND WORK BENCH 3. PLACE USED PARTS AND TRASH IN APPROPRIATE CONTAINERS

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. HAVE STUDENTS PRACTICE ON THEIR OWN, USING JOB AND TASK SHEETS
2. OBSERVE AND RETEACH AS NEED ARISES
3. CHECK STUDENTS ON KEY POINTS
4. HAVE STUDENTS PERFORM TASK AND GIVE KEY POINTS

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

PUT STUDENTS ON THEIR OWN TO PERFORM TASK. (PERFORMANCE TEST)

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

1. REPEAT EACH STEP FROM STAGE II AND EMPHASIZE PERTINENT POINTS

2. REEMPHASIZE NEED FOR SAFETY
3. STRESS POINTS CONCERNING CARE OF CUSTOMER PROPERTY
4. EMPHASIZE CLEANLINESS WITH WORK
5. REEMPHASIZE HIGHLIGHTS OF KEY POINTS

SUGGESTED READING FOR THE STUDENTS:

AUTOMECHANICS, PP. 44 - 45
AUTOMOTIVE ENCYCLOPEDIA, PP. 299 - 303
AUTO SERVICE AND REPAIR, CH. 33

THE NEXT LESSON IS: VII-E-2(S), "RECONDITION EXHAUST SYSTEM"

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JOB SHEET
IN
SERVICE HEAT RISER

VII-E-1(J)

JOB:	RECONDITION HEAT RISER VALVE ASSEMBLY
MATERIALS:	GASKETS, CLEAN RAGS, HEAT RISER LUBRICANT, PENETRATING OIL, NEW HEAT RISER ASSEMBLY PARTS, AND NEW BOLTS AND NUTS
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, DROP LIGHT, FLOOR HOIST OR JACK, SAFETY STANDS, SAFETY GOGGLES, CLEAN SEAT AND FENDER COVERS, DRIP PAN, PARTS CLEANING PAN, BRUSH AND SOLVENT, BUSHING REMOVER-INSTALLER, REAMER, ARC WELDER, HOOD, AND STEEL RODS, STRAIGHT EDGE, FEELER GAUGE, AND TORQUE WRENCH
GENERAL INSTRUCTIONS:	WEAR EYE PROTECTION, BE ALERT AND WORK SAFELY. USE REFERENCE MATERIAL AS NEEDED. PERFORM EACH STEP IN SEQUENCE. ASK QUESTIONS. FOLLOW INSTRUCTIONS.
PROCEDURES AND/OR TASKS:	VII-A-1(TS) POSITION AND PREPARE VEHICLE VII-E-1(TS) REMOVE EXHAUST MANIFOLD VII-E-1a(TS) REMOVE HEAT RISER VALVE ASSEMBLY VII-E-1b(TS) REPLACE HEAT RISER VALVE ASSEMBLY
CHECK POINT:	HAVE INSTRUCTOR CHECK EACH PROCEDURE DURING PERFORMANCE OF TASK

TASK: REMOVE EXHAUST MANIFOLD

JOB: RECONDITION HEAT RISER VALVE ASSEMBLY

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, DROP LIGHT, FENDER AND SEAT COVERS, PENETRATING OIL, HEAT RISER LUBRICANT, DRIP PAN, AND CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. IN WORK BAY, OVER HOIST OR JACK 2. CLEAR WORK AROUND VEHICLE 3. EQUIPMENT AND SAFETY STANDS NEARBY
2. PREPARE VEHICLE	1. RAISE FRONT OF VEHICLE, IF NECESSARY 2. PLACE SAFETY STANDS IN POSITION 3. OPEN HOOD AND COVER FENDERS 4. COVER SEAT WITH CLEAN COVER 5. DISCONNECT BATTERY GROUND 6. SET PARK BRAKE
3. LOOSEN EXHAUST MANIFOLD NUTS	1. SOAK EXHAUST MANIFOLD AND EXHAUST PIPE ATTACHING NUTS WITH PENETRATING OIL 2. LOOSEN EXHAUST MANIFOLD ATTACHING NUTS. (DRIP PAN UNDER MANIFOLD) NOTE: SOME MODELS MAY REQUIRE REMOVAL OF ALTERNATOR OR AIR CONDITIONING COMPONENTS BEFORE EXHAUST MANIFOLD CAN BE REMOVED 3. REMOVE EXHAUST MANIFOLD ATTACHING NUTS
4. REMOVE EXHAUST MANIFOLD	1. REMOVE EXHAUST PIPE TO MANIFOLD ATTACHING NUTS 2. SEPARATE EXHAUST PIPE AND EXHAUST MANIFOLD 3. LIFT EXHAUST MANIFOLD FROM CYLINDER HEAD STUDS NOTE: IF ANY CYLINDER HEAD STUDS WERE LOOSENED WHEN EXHAUST MANI-

STEPS	KEY POINTS
	FOLD ATTACHING NUTS WERE REMOVED, COAT NEW STUD COARSE THREAD END WITH SEALER AND INSTALL. COOLANT MAY LEAK AROUND STUD THREADS
	4. SCRAPE OFF ALL OLD GASKETS
5. CLEAN WORK STATION	1. AS IN PREVIOUS TASKS

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TASK: REMOVE HEAT RISER VALVE ASSEMBLY

JOB: RECONDITION HEAT RISER VALVE ASSEMBLY

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, BUSHING REMOVER - INSTALLER, FENDER AND SEAT COVERS, PENETRATING OIL, DRIP PAN, CLEAN RAGS, HEAT RISER LUBRICANT, DROP LIGHT, AND GRINDER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS)
3. INSPECT HEAT RISER	1. FREE MOVEMENT OF SHAFT IN BUSHINGS 2. COUNTERWEIGHT RETURN 3. OPENING AND CLOSING OF VALVE
4. POSITION MANIFOLD	1. POSITION EXHAUST MANIFOLD IN VISE OR HOLDING FIXTURE 2. POSITION HEAT RISER VALVE PLATE - WELD UP 3. GRIND SPOT WELD FROM VALVE PLATE AND SHAFT
5. REMOVE SHAFT AND VALVE	1. PRESS COUNTERWEIGHT OFF SHAFT END 2. SLIDE SHAFT FROM BUSHING IN EXHAUST MANIFOLD 3. LIST OUT VALVE PLATE
6. REMOVE SHAFT BUSHINGS	1. PRESS BUSHINGS AND SEALS FROM MANIFOLD 2. CLEAN BUSHING SEATS
7. CLEAN WORK STATION	1. AS IN PREVIOUS TASKS

TASK: REPLACE HEAT RISER VALVE ASSEMBLY

JOB: RECONDITION HEAT RISER VALVE ASSEMBLY

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, BUSHING REAMER, BUSHING INSTALLING TOOL, FENDER AND SEAT COVERS, HEAT RISER LUBRICANT, DRIP PAN, BRUSH, CLEANING SOLVENT, CLEAN RAGS, COMPRESSED AIR, ARC WELDER, STEEL WELDING RODS, WELDING HOOD, SAFETY GOGGLES

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS)
3. INSPECT MANIFOLD AND MATING SURFACES	1. CLEAN OLD GASKETS OFF CYLINDER HEAD AND MANIFOLD 2. INSPECT CYLINDER HEAD AND EXHAUST MANIFOLD MATING SURFACES FOR BURRS AND DISTORTION 3. CHECK MANIFOLD FOR FLATNESS NOTE: USE STRAIGHT EDGE OR SURFACE PLATE, CHECK FOR FLATNESS WITH FEELER GAUGE
4. INSTALL SHAFT BUSHING SEALS	1. PRESS NEW CUP SEALS INTO MANIFOLD 2. CUPPED ENDS FACING OUTWARD 3. EXTEND SEALS .100 INCH INTO MANIFOLD
5. INSTALL BUSHINGS	1. POSITION HEAT RISER BUSHING DRIVER WITH NEW BUSHING 2. DRIVE OR PRESS BUSHING INTO MANIFOLD 3. FLUSH WITH OUTER EDGE OF EXHAUST MANIFOLD
6. FIT SHAFT TO BUSHINGS	1. POSITION CORRECT SIZE LINE REAMER INTO BUSHINGS 2. LINE REAM SHAFT BUSHINGS AND SEALS 3. TEST FIT OF SHAFT IN BUSHINGS 4. REAM UNTIL SHAFT TURNS FREE IN BUSHING

STEPS	KEY POINTS
7. INSTALL COUNTERWEIGHT	1. INSTALL VALVE STOP IN SLOT ON COUNTERWEIGHT 2. FACE LOOPED END OUTWARD 3. POSITION THERMOSTAT ON COUNTERWEIGHT 4. PRESS COUNTERWEIGHT ONTO SHAFT END 5. FLUSH WITH END OF SHAFT
8. INSTALL SHAFT ASSEMBLY	1. POSITION NEW THERMOSTAT SPRING 2. INSTALL NEW SHAFT ASSEMBLY THROUGH OUTER VEHICLE 3. POSITION VALVE PLATE IN MANIFOLD, CENTER STRAP FACING FLANGED END 4. SLIDE SHAFT ASSEMBLY THROUGH OUTER BUSHING, SEALS, AND VALVE PLATE
9. POSITION SHAFT AND PLATE	1. POSITION SHAFT AND VALVE 2. ATTACH HOOK END OF THERMOSTATIC SPRING TO STOP PIN 3. VALVE CLOSED AND CENTERED BETWEEN SHAFT SEALS
10. SPOT WELD	1. ARC WELDER GROUND TO COUNTERWEIGHT CAUTION: DO NOT ATTACH GROUND AT ANY OTHER POINT. GROUND MUST BE MADE TO SHAFT AND COUNTERWEIGHT 2. WEAR PROTECTIVE WELDING HOOD 3. SPOT WELD VALVE TO SHAFT 4. INSTALL ANTIRATTLE SPRING 5. CHECK FREE MOVEMENT OF SHAFT IN BUSHINGS
11. INSTALL EXHAUST MANIFOLD	1. POSITION NEW EXHAUST MANIFOLD GASKETS ON CYLINDER HEAD MOUNTING STUDS 2. PLACE EXHAUST MANIFOLD OVER MOUNTING STUDS AND FLUSH WITH GASKET 3. INSTALL EXHAUST MANIFOLD ATTACHING NUTS (NEW) 4. TORQUE TO SPECIFICATIONS

STEPS	KEY POINTS
12. INSTALL EXHAUST PIPE	1. POSITION NEW GASKET (IF ANY USED) OVER EXHAUST PIPE ATTACHING STUDS IN MANIFOLD 2. POSITION EXHAUST PIPE INTO MANIFOLD 3. INSTALL ATTACHING NUTS 4. TIGHTEN EVENLY AND TORQUE TO SPECIFICATIONS
13. VEHICLE CHECK	1. INSTALL BATTERY GROUND CABLE 2. START ENGINE 3. INCREASE AND DECREASE R.P.M. 4. CHECK OPERATION OF HEAT RISER VALVE 5. CHECK FOR EXHAUST LEAKS
14. REMOVE VEHICLE	1. REMOVE FENDER COVER AND CLOSE HOOD 2. WIPE VEHICLE FREE OF ANY OIL, GREASE, OR HANDPRINTS 3. REMOVE JACKS AND DRIP PAN 4. PARK VEHICLE IN APPROVED AREA 5. WIPE STEERING WHEEL AND REMOVE SEAT COVER
15. CLEAN WORK STATION	1. CLEAN TOOLS AND EQUIPMENT 2. RETURN TOOLS, EQUIPMENT, AND SUPPLIES TO STORAGE 3. CLEAN WORK BAY AND BENCH 4. PLACE ALL USED PARTS AND TRASH IN APPROPRIATE CONTAINERS

INSTRUCTOR'S PLAN VII-E-2(I)
INFORMATIONAL LESSON

SUBJECT: EXHAUST SYSTEM

AIM: THE STUDENT WILL BE ABLE TO COMPARE TYPES OF EXHAUST SYSTEMS AND DESCRIBE THE CONSTRUCTION AND MATERIALS OF THE COMPONENTS.

TEACHING AIDS: TRANSPARENCIES I. ED. II 7T, FIGS. 568-574
CHALKBOARD

MATERIALS: CHALK

REFERENCES: AUTOMOTIVE MECHANICS, CROUSE, PP. 169-174
AUTOMECHANICS, GLENN, PP. 39-41
AUTO SERVICE AND REPAIR, STOCKEL, CH. 33
AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 287-292

PREREQUISITE EXPERIENCE OF THE LEARNER: THE STUDENT MUST HAVE READ THE REFERENCES FOR THIS LESSON

I. PREPARATION (OF THE LEARNER - MOTIVATION)

WE HAVE TRACED GASOLINE THROUGH THE FUEL SYSTEM TO THE CYLINDERS, SEEN HOW IT WAS IGNITED BY SPARK PLUGS, AND LEARNED THAT IT RELEASES POWER IN THE PROCESS OF CHANGING STATES. COMBUSTION IS, IN FACT, AN EXPLOSION THAT OCCURS THOUSANDS OF TIMES EVERY MINUTE IN A RUNNING ENGINE. THE END RESULT IS A MIXTURE OF GASES OF WHICH ONE IS VERY POISONOUS. HOW THE EXPLOSIONS ARE QUIETED AND THE GASES SAFELY REMOVED IS OUR TOPIC TODAY: THE EXHAUST SYSTEM.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PURPOSE OF EXHAUST SYSTEM	1. CONVEYS POISON GASES FROM ENGINE TO ATMOSPHERE 2. REDUCES NOISE BY SLOWING EXPANSION RATE OF GASES 3. COOLS THE GASES AND RELEASES THEM AT THE REAR 4. ALLOWS SPACE FOR FUEL-AIR MIXTURE IN THE CYLINDER
B. TYPES	1. CONVENTIONAL TYPE HAS ONE OF EACH COMPONENT 2. DUAL SYSTEM HAS TWO OF EACH

3. V-8 ENGINES MAY HAVE CROSSOVER PIPE CONNECTING THE MANIFOLDS
4. MANY CARS HAVE A RESONATOR BEHIND OR IN FRONT OF THE MUFFLER

C. COMPONENTS AND OPERATIONS

1. EXHAUST MANIFOLD MADE OF CAST IRON
   a. BOLTS TO HEAD OR BLOCK OF ENGINE
   b. HAS MINIMUM OF SHARP TURNS
   c. USUALLY HOUSES THERMOSTATIC HEAT CONTROL VALVE AS EXPLAINED IN LAST LESSON
   d. ALL V-8 ENGINES HAVE TWO MANIFOLDS
   e. FLANGE CONNECTS IT TO EXHAUST PIPE
2. EXHAUST PIPE COMPOSED OF STEEL
   a. MOUNTED ON HANGERS FROM CAR FRAME
   b. HAS NO SHARP TURNS OR BENDS
   c. SIZE HAS DIRECT RELATIONSHIP WITH DISPLACEMENT TO REDUCE BACK PRESSURE
   d. CONNECTS EXHAUST MANIFOLD AND MUFFLER
3. MUFFLERS VARY IN MATERIALS AND DESIGN
   a. OUTER SHELL OF TIN, STEEL, OR STAINLESS STEEL
   b. SOME HAVE STRAIGHT THROUGH DESIGN WHICH REDUCES BACK PRESSURE
   c. INSIDE COMPOSED OF CHAMBERS IN MOST
      (1) SIZE AND ARRANGEMENT HELP REDUCE NOISE
      (2) USUALLY DESIGNED TO CIRCULATE AND COOL GASES
      (3) SMOOTHES GAS FLOW BY REDUCING OVERLAP OF POWER STROKE PRESSURE
      (4) EXPANSION OF GASES REDUCE BACK PRESSURE IN CYLINDERS
      (5) CHAMBERS LINED WITH STEEL WOOL, GLASS WOOL, OR OTHER

MATERIAL
(6) MUFFLER OUTLET FITS INTO TAIL PIPE

4. TAIL PIPE CARRIES GASES TO REAR OF VEHICLE
5. RESONATOR FOUND ON MOST MODERN VEHICLES
   a. INTERNAL CONSTRUCTION SIMILAR TO MUFFLER
   b. HAS FEWER CHAMBERS
   c. ALLOWS USE OF MUFFLER PRODUCING LESS BACK PRESSURE

D. MALFUNCTIONS AND REQUIREMENTS

1. BACK PRESSURE AN IMPORTANT CONSIDERATION
   a. TOO MUCH REDUCES POWER AND GASOLINE EFFICIENCY
   b. CAUSED BY DENTS OR KINKS IN EXHAUST SYSTEM

   NOTE: REPLACEMENT OF PIPES SHOULD BE MADE WITH THOSE OF EQUAL SIZE. NEVER USE SMALLER PIPES
2. CORROSION OCCURS ON INSIDE AND OUT
   a. COMBUSTION PROCESS PRODUCES EQUAL AMOUNT OF WATER FOR GASOLINE BURNED
   b. WATER CARRIED OUT EXHAUST SYSTEM
   c. HIGH TEMPERATURE EVAPORATES WATER

SHOW: TRANSPARENCIES FIGS. 570-573

   d. SHORT DISTANCE OPERATION DOES NOT PRODUCE NECESSARY TEMPERATURES
   e. EXHAUST SYSTEM RUSTS RAPIDLY
   f. MUFFLER RUSTS OUT FROM INSIDE
3. RUST RESISTANT MATERIALS REQUIRED
   a. CERAMIC COATING ON INSIDE OF PARTS
   b. SPECIAL METAL ALLOYS SUCH AS STAINLESS STEEL MAY BE USED
4. CARBON ACCUMULATION, LEAKS, WEAR CAUSE NEED FOR REPAIRS

a. LEAKS CAN CAUSE GAS TO ACCUMULATE IN VEHICLE
b. CARBON MONOXIDE CAN CAUSE DROWSINESS AND DEATH

CAUTION: RUNNING AN ENGINE IN A CLOSED SHOP WITHOUT VENTILATION CAN CAUSE NAUSEA, DROWSINESS, AND DEATH

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

ASK QUESTIONS TO STIMULATE CLASS DISCUSSION AND CHECK COMPREHENSION OF MATERIALS PRESENTED.

EXAMPLE: WHAT ARE SOME ADVANTAGES OF A DUAL EXHAUST SYSTEM?

ANSWER: A DUAL SYSTEM PRODUCES LESS BACK PRESSURE ON THE ENGINE. THIS RESULTS IN MORE HORSEPOWER DELIVERED AND BETTER GASOLINE MILEAGE.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENTS' COMPREHENSION OF MATERIALS PRESENTED.)

TRUE - FALSE TEST

1. SLOWING THE RATE OF GAS EXPANSION REDUCES THE SOUND IT MAKES. T
2. CROSSOVER PIPES ARE FOUND IN EXHAUST SYSTEMS OF IN-LINE ENGINES. F
3. EXHAUST PIPES ARE USUALLY MADE OF CAST IRON. F
4. V-8 ENGINES HAVE TWO MANIFOLDS. T
5. THE CONNECTION BETWEEN MUFFLER AND TAIL PIPE IS CALLED A FLANGE. F
6. A SHARP KINK IN THE TAIL PIPE CAN CAUSE AN ENGINE TO USE EXCESSIVE AMOUNTS OF FUEL. T
7. RESONATORS ARE DESIGNED TO HELP DELIVER MORE POWER TO THE REAR END. T
8. WATER IN THE EXHAUST CAUSES MUFFLERS TO RUST FROM THE INSIDE. T

9. HIGH OPERATING TEMPERATURES CAUSE AN EXHAUST SYSTEM TO LAST LONGER. T

10. MUFFLERS RUST FROM THE OUTSIDE IN. F

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

EXHAUST SYSTEMS HAVE THE IMPORTANT FUNCTION OF REMOVING POISONOUS GASES PRODUCED BY COMBUSTION AND SAFELY CONDUCTING THEM TO THE REAR OF THE VEHICLE. AT THE SAME TIME IT ALLOWS GASES TO EXPAND MORE SLOWLY, REDUCING NOISE.

THESE SYSTEMS MAY BE EITHER SINGLE, DUAL, OR COMBINATIONS, BUT BASIC COMPONENTS USUALLY INCLUDE AN EXHAUST MANIFOLD, EXHAUST PIPE, MUFFLER, TAIL PIPE, AND RESONATOR.

RUST IS THE PRIMARY CAUSE OF EXHAUST SYSTEM MALFUNCTION. USUALLY STARTING ON THE INSIDE OF THE SYSTEM, IT CAN CAUSE VERY DANGEROUS LEAKAGE OF POISONOUS GAS INTO THE VEHICLE.

SUGGESTED READING FOR THE STUDENT:

AUTO SERVICE AND REPAIR, STOCKEL, CH. 23

THE NEXT LESSON IS: VIII-A-1(I), "ENGINE CONDITION DIAGNOSIS"

INSTRUCTOR'S PLAN VII-E-2(S)
MANIPULATIVE LESSON

TASK:	RECONDITION EXHAUST SYSTEM
AIM:	THE STUDENT WILL BE ABLE TO REMOVE, REPAIR, OR REPLACE THE EXHAUST SYSTEM OR COMPONENTS ON MOST VEHICLES. STUDENT WILL BE ABLE TO WORK IN A SAFE, EFFICIENT, CRAFTSMANLIKE MANNER, EXERCISING MAXIMUM APPRECIATION FOR TOOLS, EQUIPMENT, AND THE CUSTOMER'S VEHICLE. THE STUDENT WILL ALSO BE ABLE TO ACCURATELY INTERPRET INSTRUCTIONS FROM REPAIR MANUALS FOR MAKE AND MODEL VEHICLE BEING SERVICED.
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, DROP LIGHT, FLOOR HOIST OR JACK, SAFETY STANDS, TORQUE WRENCH, HACKSAW, PIPE CUTTING TOOLS, FENDER AND SEAT COVER, SAFETY GOGGLES, PIPE EXPANDER, CLEAN RAGS, WIRE BRUSH, (PNEUMATIC CUTTER WITH ATTACHMENTS-OPTIONAL)
MATERIALS:	GASKETS, PIPES, MUFFLER CLAMPS, HANGERS, BOLTS AND NUTS, PENETRATING OIL (IN CONTAINER)
TEACHING AIDS:	MANUFACTURER'S SERVICE MANUALS AND CHARTS, TRANSPARENCIES I ED. II 7 T FIG. #569, 570, 571, 572, 573, 574, 575, 576
REFERENCES:	AUTOMECHANICS, GLENN, PP. 38-42 AUTO SERVICE AND REPAIR, STOCKEL, CH. 33 AUTOMOTIVE ENCYCLOPEDIA, TOBOLDT, PP. 299-303
PREREQUISITE EXPERIENCE OF THE LEARNER:	MUST HAVE SATISFACTORILY PERFORMED THE PRECEDING TASKS IN EXHAUST SYSTEM SERVICE ALONG WITH OTHER TASKS PERTAINING TO THE JOB.
CHECKING STANDARDS:	1. SELECTION OF TOOLS AND EQUIPMENT 2. SECURE VEHICLE WITH SAFETY STANDS 3. DISCONNECT ELECTRICAL AND MECHANICAL CONNECTIONS 4. COMPLYING WITH SHOP AND SAFETY STANDARDS 5. WORKING IN CRAFTSMANLIKE MANNER 6. USE OF TOOLS AND EQUIPMENT 7. STORAGE OF REMOVED PARTS 8. CLEAN WORKING CONDITIONS

I. PREPARATION (OF THE LEARNER)

THE EXHAUST SYSTEM OF AN AUTOMOBILE CONSISTS OF THE EXHAUST MANIFOLD, EXHAUST PIPE, MUFFLER, TAIL PIPE, CLAMPS, AND HANGERS. SOME

MODELS ARE EQUIPPED WITH A CATALYTIC CONVERTER, AND SOME MAY BE EQUIPPED WITH AN EXTRA MUFFLER OR RESONATOR. IT IS DESIGNED TO CONDUCT THE BURNED GASES (OR EXHAUST) FROM THE ENGINE, SILENCE THE NOISE, AND PASS IT THROUGH THE TAIL PIPE TO THE REAR OF THE VEHICLE. THE CATALYTIC CONVERTER FUNCTIONS AS PART OF THE EMISSION CONTROL SYSTEM. EXHAUST SYSTEMS VARY IN TYPES AS TO CAR LINE MAKE, MODEL, YEAR, AND ENGINE TYPE OR SIZE. CORRECT PROCEDURES AND TOOLS ARE NECESSARY TO SATISFACTORILY SERVICE AUTOMOTIVE EXHAUST SYSTEMS. IMPROPER SERVICE TO THE SYSTEMS CAN RESULT IN LEAKAGE, CAUSING DANGEROUS FUMES TO ENTER PASSENGER COMPARTMENT, ANNOYING RATTLES, AND DAMAGE.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. POSITION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS) CAUTION: WHEN LIFTING VEHICLE BE CERTAIN LIFT PADS DO NOT CONTACT CATALYTIC CONVERTER AS DAMAGE TO CONVERTER WILL RESULT (IF SO EQUIPPED)
3. CHECK BODY OPENINGS	1. VISUALLY INSPECT EXHAUST ASSEMBLY FOR CRACKS, POOR OR LOOSE CONNECTIONS, OR DAMAGE 2. VISUALLY INSPECT UNDERSIDE OF VEHICLE a. OPEN SEAMS b. HOLES c. POOR "FIT" OF TRUNK LID NOTE: ANY LEAK IN EXHAUST SYSTEM CAN PERMIT EXHAUST FUMES TO ENTER PASSENGER COMPARTMENT THROUGH BODY OPENINGS
4. LOOSEN EXHAUST	1. APPLY PENETRATING OIL TO ALL BOLTS AND NUTS TO BE REMOVED 2. LOOSEN "U" BOLTS AND CLAMPS HOLDING TAIL PIPE TO HANGERS AND MUFFLER 3. LOOSEN "U" BOLTS AND CLAMPS HOLDING MUFFLER AND EXHAUST PIPE 4. LOOSEN EXHAUST PIPE-MANIFOLD AT -

	TACHING NUTS
5. REMOVE TAIL PIPE	1. POSITION CUTTING TOOL AT REAR OF MUFFLER 2. SPLIT MUFFLER OUTLET NIPPLE ON OPPOSITE SIDES CAUTION: IF TAIL PIPE ONLY IS BEING REPLACED, BE CAREFUL WHEN CUTTING, DO NOT CUT INNER PIPE 3. TWIST TAIL PIPE IN MUFFLER TO LOOSEN 4. PULL TAIL PIPE FROM MUFFLER OUTLET NIPPLE
6. REMOVE MUFFLER	1. POSITION CUTTING TOOL AT FRONT OF MUFFLER 2. SPLIT MUFFLER INLET NIPPLE ON OPPOSITE SIDES WITH CUTTER 3. HOLD MUFFLER WITH HANDS AND TWIST ON EXHAUST PIPE 4. SLIDE MUFFLER FROM EXHAUST PIPE END
7. REMOVE EXHAUST PIPE	1. REMOVE EXHAUST TO MANIFOLD ATTACHING BOLTS OR NUTS 2. MOVE EXHAUST PIPE IN BACK AND FORTH MOTION WHILE TWISTING TO LOOSEN IN MANIFOLD 3. LIFT EXHAUST PIPE FROM EXHAUST MANIFOLD
8. PREPARE TO REASSEMBLE	1. INSPECT MUFFLER AND TAIL PIPE HANGERS a. OUT OF SHAPE b. CRACKS AND RUST c. POSITIONING 2. INSPECT HEAT BAFFLES a. BURNED SPOTS b. CRACKS c. POSITIONING 3. INSPECT NEW PARTS a. DENTS OR DAMAGE b. CORRECT FOR VEHICLE c. DAMAGE TO GASKETS AND THREADED PARTS NOTE: CORRECT ANY UNUSUAL CONDITION BEFORE MAKING ANY INSTAL-

	LATION OF PARTS
9. INSTALL EXHAUST PIPE	1. INSTALL NEW EXHAUST FLANGE GASKET (IF REQUIRED) 2. POSITION NEW EXHAUST PIPE IN EXHAUST MANIFOLD OUTLET 3. INSTALL NEW EXHAUST PIPE ATTACHING NUTS FINGER TIGHT
10. INSTALL MUFFLER	1. APPLY EXHAUST SYSTEM SEALER TO MUFFLER AND PIPE SLIP JOINTS 2. SLIDE MUFFLER INTO POSITION ON EXHAUST PIPE 3. INSTALL "U" CLAMP AND TIGHTEN WITH FINGERS
11. INSTALL TAIL PIPE	1. APPLY EXHAUST SYSTEM SEALER TO MUFFLER AND TAIL PIPE SLIP JOINTS 2. POSITION TAIL PIPE IN HANGERS AND MUFFLER 3. SLIDE TAIL PIPE INTO MUFFLER OUTLET 4. INSTALL "U" CLAMPS AND TIGHTEN WITH FINGERS
12. ALIGN MUFFLER AND PIPES	1. SEAT MUFFLER FIRMLY ON EXHAUST PIPE OUTLET AND TIGHTEN "U" CLAMPS 2. ALIGN AND SEAT TAIL PIPE FIRMLY INTO MUFFLER OUTLET 3. HOLD PIPE IN POSITION AND TIGHTEN MUFFLER REAR "U" CLAMP 4. POSITION TAIL PIPE HANGERS AND TIGHTEN "U" CLAMPS 5. TIGHTEN EXHAUST PIPE TO MANIFOLD NUTS
13. CHECK FLOOR CLEARANCE	1. CHECK EXHAUST PIPE TO FRAME CLEARANCE 2. CHECK MUFFLER TO FLOOR PAN CLEARANCE 3. CHECK TAIL PIPE TO FLOOR AND FUEL TANK CLEARANCE CAUTION: EXHAUST SYSTEM COMPONENTS MUST HAVE ADEQUATE CLEARANCE FROM FLOOR PAN TO AVOID POSSIBLE OVERHEATING AND DAMAGE TO PASSENGER COMPARTMENT TRIM.

	TAIL PIPE MUST HAVE ADEQUATE SPACE TO FUEL TANK
14. CHECK SYSTEM ALIGNMENT	1. POSITION SYSTEM CLEAR OF FRAME, SPRINGS, AND SHOCKS 2. TORQUE "U" CLAMPS TO SPECIFICATIONS
15. CHECK EXHAUST SYSTEM LEAKS	1. LOWER VEHICLE 2. REPLACE BATTERY GROUND 3. START VEHICLE 4. CHECK ALL SLIP JOINTS FOR LEAKS NOTE: CORRECT ANY LEAKS OR RATTLES PRESENT AT THIS TIME 5. REMOVE FENDER COVERS AND CLOSE HOOD 6. PARK VEHICLE IN APPROVED PARKING AREA, WIPE STEERING WHEEL AND REMOVE COVER FROM SEAT
16. CLEAN WORK STATION	1. AS IN PREVIOUS TASKS

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

1. HAVE STUDENTS PRACTICE ON THEIR OWN USING JOB AND TASK SHEETS.
2. OBSERVE AND RETEACH AS NEED ARISES.
3. CHECK STUDENTS ON KEY POINTS.
4. HAVE STUDENTS PERFORM TASK AND GIVE KEY POINTS.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENTS' ABILITY).

1. PUT STUDENTS ON THEIR OWN TO PERFORM TASK. (PERFORMANCE TEST)

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKINGS STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

SUGGESTED READING FOR THE STUDENT:

AUTOMECHANICS, PP. 39-50
AUTOMOTIVE ENCYCLOPEDIA, PP. 299-303
AUTO SERVICE AND REPAIR, CH. 33

THE NEXT LESSON IS: VIII-A-1(S), "ENGINE DIAGNOSIS"

JOB SHEET VII-E-2(J)

ON

EXHAUST SYSTEM SERVICE

JOB:	RECONDITION EXHAUST SYSTEM
MATERIALS:	GASKETS, SEALER, CLEAN RAGS, PENETRATING OIL, NEW PIPES, MUFFLER, CLAMPS, AND HANGERS
TOOLS AND EQUIPMENT:	BASIC HAND TOOLS, DROP LIGHT, FLOOR HOIST OR JACK, SAFETY STANDS, SAFETY GOGGLES, CLEAN SEAT AND FENDER COVERS, TORQUE WRENCH, TUBING CUTTER, HACKSAW, PIPE EXPANDER, WIRE BRUSH, PNEUMATIC CUTTER WITH ATTACHMENTS (OPTIONAL)
GENERAL INSTRUCTIONS:	WEAR EYE PROTECTION, BE ALERT AND WORK SAFELY. USE REFERENCE MATERIALS AS NEEDED. ASK QUESTIONS. PERFORM EACH STEP IN SEQUENCE. FOLLOW INSTRUCTIONS.
PROCEDURES AND/OR TASKS	VII-E-1(TS) POSITION AND PREPARE VEHICLE VII-E-2(TS) PRE-INSPECTION AND REPAIR VII-E-2e(TS) REMOVE EXHAUST ASSEMBLY VII-E-2b(TS) INSTALL EXHAUST SYSTEM VII-E-1b(TS) CLEAN WORK STATION
CHECK POINTS:	HAVE INSTRUCTOR CHECK EACH PROCEDURE DURING PERFORMANCE OF TASK

TASK: PRE-INSPECTION AND REPAIR

JOB: RECONDITION EXHAUST SYSTEM

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, DROP LIGHT, FLOOR HOIST OR JACK, SAFETY STANDS, SAFETY GOGGLES, CLEAN SEAT AND FENDER COVERS, TUBING CUTTER, (PNEUMATIC CUTTER WITH ATTACHMENTS-OPTIONAL) WIRE BRUSH, PENETRATING OIL, HACKSAW, CLEAN RAGS

TASKS BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS)
3. CHECK EXHAUST AND BODY OPENINGS	1. VISUALLY INSPECT EXHAUST PIPE, MUFFLER, AND TAIL PIPE a. LOOSE CLAMPS AND CONNECTIONS b. CRACKS AND RUST SPOTS c. POSITIONING d. NEEDED REPAIRS 2. VISUALLY INSPECT UNDERBODY a. HEAT BAFFLES b. OPEN SEAMS c. HOLES d. TRUNK LID FIT NOTE: MAKE ANY REPAIRS, AT THIS TIME, TO CORRECT ANY DANGEROUS CONDITION THAT COULD LET EXHAUST FUMES INTO PASSENGER COMPARTMENT THROUGH OPENINGS IN UNDERBODY. MAKE NEEDED CORRECTIONS TO PIPE ROUTING WHEN NEW PARTS INSTALLED 3. SOAK ALL BOLTS AND NUTS WITH PENETRATING OIL 4. CLEAR WORK AREA OF ANY TRASH

TASK: REMOVE EXHAUST ASSEMBLY

JOB: RECONDITION EXHAUST SYSTEM

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: AS PER TASK VII-E-2(TS)

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSTION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS)
3. LOOSEN EXHAUST	1. LOOSEN "U" BOLTS AND CLAMPS HOLDING TAIL PIPE TO HANGER AND MUFFLER 2. LOOSEN "U" BOLTS AND CLAMPS HOLDING MUFFLER AND EXHAUST PIPE 3. LOOSEN EXHAUST PIPE-MANIFOLD ATTACHING NUTS NOTE: LOOSEN NUTS ONLY, DO NOT REMOVE AT THIS TIME
4. REMOVE TAIL PIPE	1. REMOVE TAIL PIPE ATTACHING NUTS 2. POSITION CUTTING TOOL AT REAR OF MUFFLER 3. SPLIT MUFFLER OUTLET NIPPLE ON OPPOSITE SIDES CAUTION: IF TAIL PIPE ONLY IS BEING REPLACED, BE CAREFUL NOT TO CUT INNER PIPE 4. TWIST AND PULL PIPE TO LOOSEN 5. SLIDE TAIL PIPE REARWARD AND LIFT FROM MUFFLER
5. REMOVE MUFFLER	1. REMOVE FRONT CLAMP 2. SPLIT MUFFLER INLET NIPPLE WITH CUTTER NOTE: OBSERVE CAUTIONS WHEN CUTTING 3. TWIST AND PULL MUFFLER TO LOOSEN ON EXHAUST PIPE 4. SLIDE MUFFLER FROM EXHAUST PIPE END

STEPS	KEY POINTS
6. REMOVE EXHAUST PIPE	1. REMOVE EXHAUST PIPE TO MANIFOLD ATTACHING NUTS 2. MOVE EXHAUST PIPE IN BACK AND FORTH MOTION WHILE TWISTING TO LOOSEN PIPE IN MANIFOLD 3. LIFT EXHAUST PIPE FROM EXHAUST MANIFOLD
7. CLEAN WORK AREA	1. DISPOSE OF OLD PARTS REMOVED FROM EXHAUST SYSTEM 2. SWEEP UP TRASH AND DIRT 3. WIPE TOOLS AND PLACE READY FOR USE

TASK: INSTALL EXHAUST SYSTEM

JOB: RECONDITION EXHAUST SYSTEM

TRADE: AUTOMECHANICS

TOOLS AND MATERIALS: BASIC HAND TOOLS, DROP LIGHT, TORQUE WRENCH, FENDER AND SEAT COVERS, SAFETY GOGGLES, CLEAN RAGS, HOIST OR FLOOR JACK, SAFETY STANDS, PIPE SPREADER, AND NEW PARTS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION VEHICLE	1. AS PER TASK VII-E-1(TS)
2. PREPARE VEHICLE	1. AS PER TASK VII-E-1(TS)
3. PRE-INSPECTION AND REPAIR	1. AS PER TASK VII-E-2(TS)
4. REMOVE EXHAUST ASSEMBLY	1. AS PER TASK VII-E-2a(TS)
5. PREPARE NEW PARTS	1. INSTALL PIPE EXPANDER IN PIPE ENDS OR MUFFLER NIPPLES IF NEEDED 2. TIGHTEN PIPE EXPANDER IN PIPE ENDS OR MUFFLER NIPPLES TO REMOVE BENDS OR DENTS 3. CHECK PIPE AND MUFFLER FIT TO INSURE CORRECT FITTING AND EASY INSTALLATION
6. INSTALL EXHAUST PIPE	1. INSTALL NEW EXHAUST FLANGE GASKET (IF REQUIRED) 2. POSITION NEW EXHAUST PIPE IN EXHAUST MANIFOLD OUTLET 3. INSTALL NEW EXHAUST PIPE ATTACHING NUTS NOTE: DO NOT TIGHTEN AT THIS STAGE
7. INSTALL MUFFLER	1. APPLY EXHAUST SYSTEM SEALER TO MUFFLER INLET AND OUTLET NIPPLES 2. SLIDE MUFFLER INTO POSITION ON EXHAUST PIPE 3. INSTALL "U" CLAMP ON INLET NIPPLE AND TIGHTEN WITH FINGERS
8. INSTALL TAIL PIPE	1. APPLY EXHAUST SYSTEM SEALER TO

STEPS	KEY POINTS
	TAIL PIPE SLIP JOINT 2. POSITION TAIL PIPE IN HANGERS AND MUFFLER OUTLET NIPPLE 3. SLIDE TAIL PIPE INTO MUFFLER OUTLET NIPPLE 4. INSTALL "U" CLAMPS AND TIGHTEN WITH FINGERS
9. ALIGN MUFFLER AND PIPES	1. SEAT MUFFLER FIRMLY ON EXHAUST PIPE OUTLET AND TIGHTEN "U" CLAMP 2. ALIGN AND SEAT TAIL PIPE END INTO MUFFLER OUTLET NIPPLE 3. HOLD TAIL PIPE IN POSITION AND TIGHTEN MUFFLER REAR "U" CLAMPS 4. POSITION TAIL PIPE IN HANGERS AND TIGHTEN "U" CLAMPS 5. TIGHTEN EXHAUST PIPE TO MANIFOLD ATTACHING NUTS
10. CHECK FLOOR CLEARANCE	1. CHECK EXHAUST PIPE TO FRAME CLEARANCE 2. CHECK MUFFLER TO FLOOR PAN 3. CHECK TAIL PIPE TO FLOOR PAN AND FUEL TANK CLEARANCE CAUTION: EXHAUST SYSTEM COMPONENTS MUST HAVE ADEQUATE CLEARANCE FROM FLOOR PAN TO AVOID POSSIBLE OVERHEATING AND DAMAGE TO PASSENGER OR TRUNK COMPARTMENT TRIM. TAIL PIPE MUST HAVE ADEQUATE SPACING AT FUEL TANK
11. CHECK SYSTEM ALIGNMENT	1. POSITION MUFFLER AND PIPES CLEAR OF FRAME, SPRINGS, BODY, AND SHOCKS 2. TIGHTEN ALL "U" CLAMPS AND NUTS TO SPECIFICATIONS
12. CHECK EXHAUST	1. LOWER VEHICLE 2. REPLACE BATTERY GROUND 3. START ENGINE 4. CHECK ALL PIPE CONNECTIONS FOR LEAKAGE NOTE: CORRECT ANY LEAKS OR RATTLES NOTED AT THIS STAGE

STEPS	KEYS POINTS
13. SECURE VEHICLE	1. REMOVE FENDER COVERS AND CLOSE HOOD 2. WIPE VEHICLE CLEAN OF ANY OIL, GREASE, OR HAND PRINTS 3. PARK VEHICLE IN APPROVED PARKING AREA 4. WIPE STEERING WHEEL WITH CLEAN RAG AND REMOVE SEAT COVERING
14. CLEAN WORK STATION	1. CLEAN TOOLS AND EQUIPMENT AND RETURN TO STORAGE 2. DISPOSE OF ALL TRASH 3. CLEAN WORK BAY AND WORK BENCH